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DEPRECIATION.

"The subtraction of ordinary or current operating expenses and taxes from gross earnings does not represent net earnings available either for interest on bonds or dividends on stock. It is high time that the electric lighting interests of the country awaken to the full realization of this fact." With these ringing words, Mr. C. N. Duffy closed his paper on "Depreciation" before the Northwestern Electrical Association Convention at Milwaukee last month. Depreciation is an item which has been most skilfully dodged and manipulated in central station bookkeeping for many years. The day is soon coming when it must be reckoned with in a more practical way than in the past. As a matter of fact, a great many of the smaller electric lighting companies of the country have been taking care of depreciation for a number of years without really maintaining a depreciation item on their books. This has been done by putting back into a property for enlargements and improvements a percentage of the profits each year. The practical effect of this has been to keep the property at its original value or even to increase this value; so that while depreciation there was continuous, the property was nevertheless made better by enlargements and improvements paid for out of receipts from operation. In other cases depreciation has simply been neglected in order to make large dividends. The second method is, of course, financially indefensible and sure to result in grief sooner or later, while the first method, while financially sound, is likely to result in trouble when questions of equitable rates are raised.

In short, depreciation should be called by that name and not by some other. If a company has not been recognizing depreciation on its books, it is in a poor position to argue before a public investigating committee or commission that such depreciation should be taken out of net profits before the real profits available for dividends are figured. To be sure, if a commission of competent experts is called upon to pass on the question, it will recognize depreciation in any event, whether the company has recognized it in its bookkeeping in the past or not. The company is in a decidedly difficult position when it attempts to explain to a body of non-technical men why depreciation should suddenly be recognized when it has been ignored for years. The company which keeps a proper depreciation account and actually lays aside and invests in good securities its depreciation reserve year by year, or if it invests that reserve in its own bonds, issued to pay for improvements in its own property, it is of course no better off as to tangible assets than if the same amount of money was simply put back into the property and charged to the general expense account of each year. There would be this important difference, however, that the company with a separate depreciation account would be in a position to tell much nearer where it stood as regards its provision for depreciation and that it would be in a position to invite investigation as to rates and profits. The apparent profits would not be so large—nor indeed the real profits, for depreciation is a vital item to include.

Interior Wiring.

Until we reach an era of wireless electric lighting, which is certainly not in prospect or in present conception, we shall continue to have house-wiring and house-wiring troubles. Not even the millennium would be likely to eliminate them completely. On the other hand, however, the science and art of industrial house-wiring have made very great strides since public electric lighting commenced, and there is every reason to expect that they will continue to advance. The article by Mr. W. J. Canada, elsewhere in this issue, summarizes the conditions that exist in the widely scattered lighting districts of the Rocky Mountain region, as viewed from the insurance inspection standpoint. The territory referred to has an area of nearly half a million square miles, a population density of about ten per square mile, a large number of scattered villages and small towns, but only a few large cities. The problem of maintaining a proper standard of wiring and equipment in such a territory is clearly very different from the corresponding problem before a city like New York with its four millions of inhabitants.

In the electric lighting business we have four different parties involved; namely, the central station, the wiring contractor, the householder and the fire insurance underwriter. If each building were completely detached from its neighbors and were owned by its occupant without insurance, the problem would be simpler, but more primitive. If the householder wired his house in a recklessly dangerous way, so that at some time an accident was thereby invited and the house damaged by fire, he would have none to blame but himself for his loss of property. This consideration would be likely to make the householder more careful as to the class of workmanship and material which he employed in wiring his house. When, however, the fire loss is distributed over a large section of the community through the mechanism of the fire-insurance corporation, the conservative self-interest of the individual householder in inspecting his own house-wiring is naturally reduced and is delegated to the insurance underwriter. This introduces the fourth party into the transaction, with increase in liability to friction, but with better ultimate sociological results. The object of the householder is now to get his house wired at the minimum expense, including fire insurance. The wiring contractor, in the absence of the insurance inspector, would be obliged to reduce the cost of material and labor in house-wiring down to the lowest terms either because of business competition or because the householder would not otherwise accept the contract. Consequently, if the insurance inspector did not set limits to the quality of the material and labor on which the insurance risk would be accepted, the business tendency would be to force the contractor into a cheaper class of work than he would desire of his own will to install. On the other hand, not every insurance inspector is qualified to pass upon the merits of a wiring installation. An imperfectly qualified inspector is able to create a large amount of hardship and vexation to the wiring contractor by insisting on some details that may be very difficult to alter. No playwright seems yet to have discovered the opportunity that is afforded for a ludicrous farce by the opposition of interests between an unbusinesslike insurance inspector and an unbusinesslike wiring contractor; but the possibilities in this direction are well known to those who come into contact with the wiring business.

In general, the four-party system has worked much better than might have been supposed. The modern house-wiring installation in the large cities is manifestly much better and safer than it used to be 15 years ago, while the cost per outlet to the house owner has not increased in anything like the degree of improvement in construction. The difficulties to be adjusted between the work of the four parties involved have been largely settled by mutual compromise, invention and experience, so far as concerns the wiring of houses in large cities, and the National Code has done good service in this matter. The main difficulty has now shifted from the big cities, where the business is systematized, to the small towns and villages, where good inspection is more difficult to secure and good wiring is also hard to obtain. One comfort is that if wiring conditions are apt to be more lax in the small towns and country districts than good workmanship secures in large cities, yet the buildings are likely at the same time to be more scattered. Consequently, although defects in wiring may give rise to occasional fires, the fires are not likely to be as disastrous as in the big cities.

Modern German Arc-Lamp Photometry.

As noted in our Digest column this week, an account has appeared recently in the *Elektrotechnische Zeitschrift* of the photometric arrangements in a modern arc-lamp factory in Germany which possess features of special interest. The equipment is placed in two fairly large rooms, one dark and the other light. The dark room contains the principal photometric apparatus, while the light room enables the floor illumination produced by different ceiling lamps to be studied comparatively. The apparatus used for spherical candle-power measurements is a large metal globe about 10 ft. in diameter. The observer stands on the outside of this globe and takes a photometric reading through a peep-hole in the globe casing. The globe contains the arc lamp under test, suspended near the center, although not necessarily just at the center. The inner surface of the globe is painted a dull white, so that the light falling upon any point may be absorbed as little as possible and scattered as much as possible. The luminous intensity of any part of the internal wall will then be proportional to the total amount of light emitted by the arc lamp; or, in other words, to the spherical candle-power of the same.

In this country, when the mean spherical candle-power of an arc lamp is measured at a single observation, which is not so very often, the Matthews apparatus is usually employed with a number of inclined mirrors, all directing beams of light at different angles into the photometer. The arc lamp is looked at, as it were, in the photometer, from eight different elevations at once, and the proper mean spherical candle-power is automatically deduced from the joint observation. The Ulbricht globe may be described as an apparatus with an infinite number of such mirrors, each of microscopic size, formed of minute particles of a crystalline substance like plaster of Paris. At the same position that the observer takes to look into the highly illumined sphere, a small image of the arc is capable of being seen independently. The image of the arc is projected on the wall of the room, behind the observer, through a suitably placed orifice, and this image can be viewed by the observer through a mirror in front of him. In this manner he is able to observe the arc at any time during the test, without straining his eyes, and to satisfy himself that the arc is behaving satisfactorily at the time the spherical candle-power is being observed.

GAS PHOTOMETRY.

The report of the candle-power committee of the American Gas Institute, an abstract of which is given in the Digest, is one of the ablest and most exhaustive scientific reports that it has ever been our fortune to read. It is really a model of painstaking and accurate work and should be filed away as of permanent value to everyone interested in photometry. In reading it the enormous difficulty of the situation from the standpoint of the gas engineer is made evident. The photometrist who deals only with electric lamps has no proper conception of the troubles that confront his confrère. Reading this report his attitude should become more sympathetic. At the beginning rises the fact that the only legal standard used in this country is the British candle, whatever that may be, and with state and municipal gas inspectors the candle, for that reason, retains its supremacy. It is known to be a bad standard both for primary and secondary purposes, yet from its legal recognition it must be taken seriously until some better standard shall have replaced it. We will not attempt to rehearse its failings, which are many, referring the reader to the original report for a full account of them. Of late many gas companies have adopted the 10-cp Hartcourt lamp, intended to equal 10 British candles, but it is worthy of note that only three official inspectors have followed the practice, so that the candle still reigns.

The fundamental trouble in gas photometry is that the thing measured is a flame which is subject to considerable variation in intensity according to the character and composition of its air supply. Any variation in temperature, density, CO_2 content, humidity and so forth is at once powerfully felt. Hence the obvious necessity of comparing flame with flame in order to compensate to as great an extent as possible for these variations. It is quite certain that flames almost universally differ among themselves in the absolute effect of these disturbing elements, so that the most that can practically be done is to choose a standard flame which will reduce the corrections to a reasonable limit when comparisons are made with a gas flame. The incandescent lamp, otherwise by far the most desirable working standard, is objectionable in gas photometry on account of introducing too large corrections; that is, corrections of the full value of those applied to the gas flame and not merely differential values, as in comparing one flame with another. The need for uniform atmospheric conditions necessitates extreme care in providing ventilation and uniform temperature in the photometer room, resulting in the very complex specification for photometer room construction set forth in this report. And the fact that flames are being compared, which may flicker and vary slightly, handicaps the photometrist by making it difficult to use without undue fatigue the Lummer-Brodhun screen. The Leeson screen, which seems to be the favorite, is a pretty good one, but in electric lamp photometry the Lummer-Brodhun has a very considerable advantage in precision, so that the number of settings necessary to bring down the probable error to a minimum is greatly decreased. For this reason the Lummer-Brodhun screen will very soon pay for itself in time saved. Most observers consider it more tiresome than a Bunsen or Leeson disc which is observed with both eyes, but it thereby avoids the serious errors due to variation as between the eyes.

The search for something better than candles as a standard has led gas photometrists to a rather general preference for the Harcourt lamp, while the electric contingent has rather favored the Hefner. The conspicuous virtue of the Hefner is that its rather moderate corrections have been more exhaustively studied than in the case of any other primary standard, and that certified lamps are easily obtained. Intrinsically it is not a good standard for practical comparisons, being of inconveniently small intensity and of peculiarly troublesome color. The Harcourt lamp appears to be less well-determined in corrections, but is incomparably more convenient to work with in comparing it with gas flames. Especially, it has the very great practical advantages of convenient intensity and excellent color. Probably, primarily on account of its British origin, it has been adopted by most if not all of the English engineering bodies concerned with lighting, including both the Institution of Electrical Engineers and the Institute of Gas Engineers. It is therefore most unfortunate that the value of the conventional British candle, determined as one-tenth of the Harcourt, should differ by about 4 per cent from the value of the candle as derived from the comparisons with the Hefner and used as the electrical standard in this country. Some years ago the A. I. E. E. committed itself, in lack of better, to the Hefner as a standard, taking it as .88 of the British candle in view of the comparisons then available. It has therefore come about that the electric and gas interests in this country are, so far as now seems probable, nearly 4 per cent apart in the value assigned to the British candle, our only legalized standard.

It is unfortunate that the subject of units of light has been approached by those interested with so little unity of action There has been no international work on the subject in which the gas and electric interests have concurred. Some years ago the Violle platinum standard was solemnly accepted by an International Electrical Congress, only to pass into *innocuous desuetude*. Later the International Photometric Commission appointed on the initiative of a Gas Congress took up the work, and it was this body that reported at Zurich last summer. Here in America there is good prospect of some concerted action, since a joint committee of the Illuminating Engineering Society, the American Gas Institute and the A. I. E. E. has now been organized for the purpose of agreeing upon a programme which will bring all the interests into joint action as regards the actual unit of light to the extent, it is hoped, of getting real international action before the issue is decided. If all hands could only settle upon a unit of light, by whatever name it should be called, then the matter of a concrete primary standard could be left to settle itself, as each country would define the unit in terms of its own favorite standard, pending at least further action. There would then be a certain definite unit in use everywhere, and it would be possible to have something like a definite nomenclature in matters of illumination. So far as gas photometry goes, it will always, so long as gas flames are used, have to fall back on flame comparisons. The very general use of mantle burners introduces a new complication in the way of getting a suitable flame as a standard; but with a definite unit once adopted there would at all events be a general agreement as to the amount of goods delivered, and the selection of a method for their measurement could be trusted to settle itself in due time.

A Study of the Illumination of Interiors.

On account of the present interest in illuminating engineering we print elsewhere in this issue some interesting figures, taken from a thesis written by Messrs. Legg and Townsend at the University of Wisconsin in 1901. The two most prominently instructive features of this thesis are the figures given on the effect of dust on lamps and reflectors, and on the conditions existing by night and by day in several public libraries and other buildings. We do not imagine that the figures given on the effect of dust represent anything extraordinary, but are probably somewhere near average conditions in the down-town districts of large cities, where the janitor service is not exceptionally efficient. These tests show losses due to dust varying from 75 per cent to 8 per cent, the average reading at seven stations being 28 per cent. It is also interesting and instructive to compare the daily illumination in the various buildings with the artificial illumination. As would be expected, the average daily illumination was very much higher than the artificial, the average of artificial illumination on the library tables being 1.98 foot-candles, as against 15.7 for daylight. This shows that artificial illumination has far to go before it reaches the average of daylight illumination. It also shows that the human eye can work with comfort over a very wide range. Until we get better methods of diffusing the light from artificial illuminants than we have commonly at present, an attempt to increase artificial illumination to make it nearly equal to daylight is sure to prove diastrous. There is a great difference in the quality of the diffused light received by day from the sky and clouds and that received by night from powerful sources of artificial light placed within a room. As to the range within which the human eye can work with comfort, the average values of artificial and daylight illumination just quoted do not begin to tell the whole story. Daylight illumination as high as 104 foot-candles was observed in one case, while in the same room on the same day at about the same time an observation was made as low as 3.4 foot-candles, this great variation being due to the sun breaking through the clouds at intervals. An observation of less than 1 foot-candle on a library table in daytime was also recorded.

Changing Show-Window Lighting to Flat Rates.

The account, in this issue, of the work that is being done by the central station at Dubuque, Ia., to change show-window lighting from flat to meter rates is interesting as showing what can be done in small cities in the way of increasing revenue from this class of business and putting it on a better basis, both for the central station and the merchant. There is nothing new about the proposition of changing show-window and sign lighting to flat rates, but it should be kept to the front as a matter of practical financial importance to central station companies. There is no question that a merchant's show window is one of his best forms of advertisement. Many people do a large part of their selection of goods from what they see in show windows, which is supposed to represent the latest and best in every line which a merchant has to offer, as well as to call attention to special bargains. In other words, it tells the passer-by in a few glances what it might take him considerable time to find out otherwise. To have show windows dark in the evening is to lose their advertising value for some of the most important hours of the day. A well-lighted show window at night is more attractive than the same window is by day. In a small town where all show-window lighting is connected on a meter basis, it is likely that when the store is closed up the window lighting is turned off. This is especially true in the case where the merchant does not feel like providing for turning off window lighting at 11 p. m. or later. Even where someone is detailed to turn off these lamps, there is a temptation for the merchant to economize by leaving his windows dark on some of the duller nights of the week. The most practical way out of the difficulty is the one which has been adopted in so many places—namely, to disconnect the window lighting from the meter and take it on a flat-rate contract, under which the merchant agrees to pay a certain flat rate per month for lighting of his windows a certain number of hours each evening, the turning on and off to be performed by the company. The company determines the rate on the basis of kw-hours, but because of the greater number of hours' use of the window lighting, it can afford to make a lower figure than for other commercial business, unless a readiness-to-serve or a maximum demand system is in vogue, in which case the same basis can be used. Such a system of rates at once incites interest, and as at Dubuque, many are willing to provide better window lighting under its favorable terms. This has its effect on other merchants, the general standard of show-window illumination in the down-town district is raised, and dark windows become more conspicuous by their darkness. While the general lighting of a store interior in a small town, where early closing is the rule, is not a remarkably profitable proposition for the central station, owing to its poor load-factor, lighting of the show windows is an excellent kind of load. It is the kind that it pays to spend money to cultivate. It is much better spent on this than on trying to increase the maximum demand from the lighting of the interior of the store.

The Age of the Tiny Fan.

Anyone visiting recent electrical shows like that at Chicago last month could not fail to be impressed with the increasing popular use of the tiny electric motor as applied to vibratory massage, hairdrying, polishing and other popular uses. These appliances, while they cannot be figured upon to produce any certain great volume of revenue to a central station, nevertheless aid in popularizing central-station service, and where used add a little to the income from a number of customers. It is probable that there are many more useful applications of very small motors which have not been developed as yet. In this connection it is rather remarkable to note that for many years fans operating from electric lighting circuits were all of such size as to be entirely too strenuous for the ordinary desk use of a single person, except when running very inefficiently at slow speeds. Recently smaller sizes have been increasing in popularity, and justly. In spite of the fact that the electric motor has been a commercial article for so many years, it is only in the beginning of its use as a household servant in its smaller sizes.

Renewals of Expensive Lamps.

With the advent of the tungsten lamp, a very important question comes up in central station policy as to whether these lamps shall be purchased by the customer or whether the central station company, which has heretofore furnished free lamp renewals, shall supply them on some kind of a basis which will enable the company to make a profit. In the case of the tungsten lamp selling at over $1, the furnishing of free tungsten

lamp renewals is usually out of the question. On the other hand, if the customer furnishes tungsten lamp renewals entirely, there will be a tendency to get away from some of the fundamental advantages of the free lamp renewal system. It is generally recognized that one great advantage of the free lamp renewal system is that it gives the customer a better quality of lamps than he would be able to purchase in the open market in small quantities with no means of testing their quality. It also has the advantage of relieving the customer from inconvenience and of keeping the lamp sockets of his installation filled with good lamps, where otherwise some would remain empty. Probably one of the best solutions suggested of this problem of renewals on tungsten lamps is to furnish the lamp renewals free, provided the customer agrees in return to pay a certain additional rate per kw-hour. Such contracts as this would naturally be made only with some of the larger and more important customers, who would appreciate that the actual saving or the increased illumination resulting from the use of the tungsten lamp justified the arrangement, which could not very well be made with small customers. For large customers who understand the conditions thoroughly, a maintenance charge of a certain amount per kw-hour for tungsten lamps, the lamps to be renewed free by the central station company, should prove a very satisfactory arrangement. As the prices of tungsten lamps are reduced, this maintenance charge could be reduced in the same proportion.

It should be, on the whole, much more satisfactory for the large customer to pay for lamp renewals in this way than to purchase lamps direct. Unless he is a very large customer, indeed, he has no facilities for testing or keeping records of lamp performance, and to have this testing done would be an expense out of proportion to the size of the installation. The central station, on the other hand, is in a position to look after the matters of checking and testing much better than the customer. Besides this, the central station would buy in much larger quantities, and hence get a better price. If the customer contracts for lamp maintenance at a certain price per kw-hour, he has a definite idea what his illumination will cost him. If he purchases lamps in the open market, there is considerable uncertainty, even if he gets the advice of technical men, unless this advice can be followed up with a rather cumbersome system of records and testing. In the case of the small customer with a mixed installation of tungsten and old-fashioned carbon lamps, the practice already in vogue in some companies of supplying the more expensive lamp at the difference in price between the common carbon lamp and the more expensive lamp, will probably work out the best. There is no reason why both of the policies outlined cannot be pursued by the same company, giving the customer his choice. To companies which are not now furnishing free renewals, none of these lamp-renewal problems present themselves; but the fact remains that it is well for any company to keep as firm a hold of the quality of lamps placed on its lines as it possibly can in order that satisfactory service may be received by consumers.

RATIONAL FIXTURE DESIGN.

The paper on "Fixture Design from the Standpoint of the Illuminating Engineer" recently read before several sections of the Illuminating Engineering Society apparently met with a very favorable reception by the rank and file of the members of that society who are seeking for practical suggestions as to methods of improving illuminating results with existing fixtures without varying too much from the well-beaten paths of fixture design. It has sometimes been said that the illuminating engineer has too little regard for the artistic. Such papers as that referred to show that a great many of the common artistic ideas in fixture design, be they right or wrong from an artistic standpoint, are not by any means inconsistent with good illuminating design, provided the proper details are carried out. For example, we frequently hear art-glass fixtures condemned by the wholesale as being contrivances of the evil one with which it is impossible to produce good illuminating results under any circumstances. There is no inherent reason why art-glass fixtures cannot be built which will give excellent illuminating results for certain conditions, and at the same time resemble so closely those now commonly seen that the ordinary observer would notice nothing unusual about them. The art glass may in some cases be very useful as a diffusing screen to keep glare out of the eye. The box type of fixture is capable of great development along scientific lines, care being taken either to leave the bottom open or to cover it with a diffusing glass which will not absorb much light. The same principles can be applied to art-glass lanterns, provided the design of the lantern is such as to let out useful light through the bottom, utilizing the art glass sides simply as shades and diffusers.

In ceiling hemispheres we have a very satisfactory means of diffusing and softening light and of obviating the necessity of conflicting with the ideas of the architect through the use of obtrusive hanging fixtures. Unfortunately, the ceiling hemisphere has commonly been used in a very inefficient manner in the past, and without any attempt to recover and utilize the 50 per cent of light which goes upward from the incandescent lamp when used without a reflector. The use of efficient reflectors inside of ceiling hemispheres would seem to be the most obvious improvement. Such a practice has been advocated by various illuminating engineers for some two or three years. So slowly do progressive ideas percolate among fixture manufacturers, however, that it is only with considerable trouble and annoyance at the present time that the average customer can procure ceiling hemispheres with proper interior equipment. It is unfortunately true the country over that fixture makers and dealers are taking little or no interest in illuminating engineering. They are rather waiting for customers to demand and drive them into making improvements which will secure better illuminating results. One would think that before this any number of enterprising fixture houses would in their own interests have begun to look after effective illumination for the sake of standing well with customers, but such does not appear to be the case. It seems rather to be a case of the fixture dealer blaming the architect and the architect the fixture dealer. In the meantime we must look for most of our improvement in illuminating results to central-station men and electrical contractors, who usually have some appreciation of technical points and who, by dint of much insistence, may be able to get the fixture men to supply what they specify, even though the fixture man may, as is often the case, make strenuous efforts to substitute some stock standard of inefficient design. When the day comes that efficient designs become the regular stock articles instead of the special exceptions, as now, efficient illumination will be much more common.

International Independent Telephone Association Convention.

The International Independent Telephone Association held its annual convention in the Coliseum Annex at Chicago, Jan. 21, 22 and 23, during the last week of the Electrical Show. But one session was held daily. The first meeting was called to order at 2:20 p. m., Jan. 21, with President Theodore Gary, of Macon, Mo., in the chair. An address of welcome to the city was given by Assistant Corporation Counsel Miller, representing the mayor of Chicago. In this address he indicated that the present city administration was endeavoring to dispel the idea fostered by the previous administration, that the city of Chicago had a club out for all corporations. Speaking for the present administration, he said that it was in favor of a square deal for all interests. Mr. M. L. Clawson, of Indianapolis, responding for the association, appealed to Chicago to grant a franchise to an independent telephone company, pointing out that independent telephones in surrounding states reached a larger number of subscribers than Bell telephones.

President Theodore Gary then gave his annual address. He announced that the association had just been incorporated under the laws of Illinois. He suggested a publicity campaign to encourage greater use of the telephone, to cost $25,000 a year. Such a campaign would be along the co-operative lines suggested by Mr. J. Robert Crouse, of the Co-operative Electrical Development Association, for central station companies. He mentioned the equipment stamps sold by the association to manufacturers of independent telephone apparatus and supplies, for attachment to equipment furnished by independent telephone companies. He suggested that these stamps had not been as generally used as they should be, and that hereafter instead of having them placed on the goods themselves, they be attached to the invoice, and that all independent operating companies request that such stamps be affixed to invoices.

The report of Assistant Secretary Mr. J. A. Harney was heard, and he announced the removal of the headquarters of the association from Cleveland to 629 Monadnock Block, Chicago, since the last annual convention in June. He said the state and local associations had paid but a small percentage of the assessments levied against them. Some figures he had compiled as to the percentage of duplication of Bell and independent subscribers in 12 cities showed this duplication (that is, the number of subscribers having both telephones) to be less than 8 per cent. The greatest percentage of duplication seemed to be in large cities. For example, cities of 6000 to 8000 inhabitants have a duplication of only 5 per cent, and those of from 50,000 to 100,000 ten per cent.

The advisory board made a report in which it recommended that inasmuch as the assessments levied on various state and district organizations under the rules had not been fully paid, these assessments should be reduced, as they are too high. He introduced a resolution reducing the assessment to two mills per unit on all independent telephones in the territory. One unit consists of one telephone instrument or one mile of toll line. Only 13 per cent of the assessments levied have been paid. The manufacturers' contributions were also found fault with. A resolution was recommended to the effect that stamps to the value of one-tenth of 1 per cent of the amount of each invoice be attached to all invoices by manufacturers selling telephone supplies, and by publishers of telephone journals, where the amount of the invoice is less than $500, and one-twentieth of 1 per cent for amounts over $500; and that all member telephone companies be requested to insist that such stamps be affixed. These stamps would be sold by the assistant secretary of the association. The recommendation and resolutions of the advisory committee were adopted. The convention then listened to the reports of the various state and provincial organizations. All of those heard from reported a good increase in the number of independent telephones. The delegate from Indiana spoke of a general raising of rates among telephone companies in that state. In fact, the raising of rates by telephone companies has become so common that they ceased to attract attention. The state of Indiana, outside of the large centers, was apparently almost given over to independent telephony. At this session a paper entitled "The Banker's Opinion of Securities," by Mr. E. H. Moulton, of Minneapolis, Minn., was read, in which the author expressed the opinion that telephone securities were gilt-edged, being based on a public necessity which is not likely to be dispensed with in hard times.

The Wednesday morning session was largely taken up with matters pertaining to the raising of money and conduct of the association, and with the question of whether delegates should be recognized or not where state associations they represented had not paid assessments in full. Nearly all of the states were more or less delinquent. A compromise was fixed up whereby each state association would be represented by delegates to the amount it had paid.

Mr. F. D. Houck, of Harrisburg, Pa., stirred up the convention by a paper on "Organization and Co-operation," in which he did some very plain talking to the effect that in the last few years the association had been doing little of practical benefit for the independent telephone movement, although if properly conducted it should be very useful. As a matter of fact, its meetings consisted simply of a display of oratory, but nothing practical came from it. He favored a business-like organization with a strong man of ability at its head, this man paid a sufficient salary to devote his entire time to directing association affairs and given facilities for carrying on the work. The present arrangement, with only an assistant secretary and a stenographer giving their entire time to the association, was entirely inadequate for an organization representing $300,000,000 invested capital. True, the association had not been able to raise money. He believed the reason was there were many companies like his own which were not able to see that they could get any good out of the association the way it had been run. He offered to be one of 100 companies to give $100 each for a $10,000 fund to start out the association at once to doing business the right way. This paper brought on a great deal of discussion, nearly all those taking part agreeing that more money should be spent if it could be raised. Finally the plan was decided upon of asking the various larger companies represented to guarantee to make up a certain percentage of whatever deficit there might be in a $15,000 fund for the coming year. It was understood under this arrangement that these companies would not be called upon to make up much deficit should the assessments of the various state associations be paid. This fund was guaranteed in a few moments by large and small companies and state associations.

Tuesday morning at 10:40, after an invocation by Rev. Jenkin Lloyd Jones, a paper on "The Business End of the Business" was read by James H. Shoemaker, of Waterloo, Ia. Some of the things he called attention to were the reduction of the cost of collections and the importance of adopting some unit by which the cost of service and its efficiency could be measured. He suggested as such a unit of quantity in the telephone business the "minute message mile." He also intimated that charges for making service connections would be in order, as such charges are expected by many new subscribers and are so recognized as just. He discouraged the practice of trying to cover too much territory with a limited capital and also the practice of putting earnings back into extensions and passing dividends to the detriment of the financial standing of the stock. It was announced that the guarantee fund of $15,000 pledged verbally in convention the day before had been subscribed to in writing since the last session, and was then up to 108 per cent. This was later raised still further by voluntary subscriptions during this session of the convention. A short address on "Why the National Grange Favors Competition" was made by Mr. George F. Gaunt, of Mullicka, N. J. He said that this strong organization of farmers was thoroughly in sympathy with the independent telephone movement, and so expressed itself at its convention, because the independent movement had been the means of putting farmers into telephonic communication with the outside world.

Mr. R. Max Eaton, of Niagara Falls, N. Y., read a paper on "The Solution of the Telephone Situation." He took up first the two-telephone problem which had bothered many subscribers in cities where two exchanges existed. He held that this existence of two telephones in many subscribers' premises was not due simply to the shortsightedness of the Bell companies in years past in failing to extend and develop the telephone business as it should have been developed previous to the independent movement, nor was it due simply to prejudice against the Bell monopoly. It was due, he thought, to a fundamental economic principle of telephone work which is that the message cost increases as the number of operating units connected to the exchange increase. Thus, in New York City, the cost of telephone service is necessarily higher than in smaller cities of New York State. Although not specifically stated, the inference drawn from his remarks was that subscribers could be more economically served by two systems of small size than by one large system. The cost of service depended on the number of subscribers connected to a system. The ideal system would provide an increased rate as the number of subscribers increased. Measured service was unquestionably the proper thing if rightly carried out. He then discussed some of the defects of common methods of measuring service and advocated measuring the time that a subscriber's instrument is in service and charging upon that basis. This, he thought, would overcome the practical difficulties of other methods. He urged manufacturers to promote the production of something of this kind. He favored more complete use of the copper circuits which are now erected. He pointed out that there was enough copper in the shape of telephone and telegraph lines to enable the country at present to handle much more business than is now transacted if proper use were made of these circuits to get the most out of them. To do this it might be necessary to make some kind of a consolidation or working agreement between telephone and telegraph companies so as to use lines simultaneously for telephony and telegraphy.

"The Independence of the Independents," by Mr. W. H. Denlinger, of Patton, Pa., was the subject of the last paper read. A number of other papers were presented by title only and ordered printed.

The election of officers resulted as follows: President, A. C. Lindemuth, of Richmond, Ind.; vice-president, P. C. Holdogel, of Iowa; second vice-president, E. B. Fisher, of Michigan; third vice-president, J. F. Demers, of Quebec; fourth vice-president, Arthur Wright, of California; secretary, J. B. Ware, of Michigan; treasurer, Manford Savage, of Illinois.

Controversies Over Electric Rates.

A controversy of much interest and importance to electric light companies the country over has been going on for several months at Minneapolis, and is not settled at present writing, though the sky is clearing. The city officials started out with the proposition that the rates of the Minneapolis General Electric Company were entirely too high, and that the same rate per kw-hour should be made for all consumers without regard to conditions of load, except for quantity discounts. The Minneapolis General Electric Company had, of course, been following the example of all safely managed large central station companies and had put in force a system of rates under which customers having the best load factors (that is, using current the largest number of hours per day) were given much the lowest rates. It appears from the reports of the early stages of the Minneapolis controversy that the city officials were chiefly concerned with lowering the maximum rates charged by the company for short-hour business. As a result of this controversy between the city and company, several expert investigations have been made of the company's affairs. The result of these investigations have all been to uphold the correctness of the company's theory of readiness-to-serve charges in connection with electric light and power business. It is, of course, inconceivable how any expert familiar with the business could come to any other conclusion after a careful study, but the Minneapolis case will be of value to all electric light and power companies in helping to establish more firmly the correctness of the principles which are most likely to be questioned by city officials and others not familiar with the business. The experts at Minneapolis, who included such men as Prof. Mortimer E. Cooley, of the University of Michigan; Messrs. D. C. and W. B. Jackson, of Madison and Boston; Andrew Rinker, city engineer, and Mr. C. L. Pilsbury, of Minneapolis, all agreed that the rates given to any individual customer should be dependent upon the fixed charges on the investment necessary to serve him, plus operating expenses, rather than on the average expense of serving all classes of customers. However, as a concession to the smaller customers, it seems to have been generally agreed both by the company and the experts that the maximum rates should be a little lower than those to which the smaller short-hour customers would be strictly and scientifically entitled, although a reduction of these maximum rates to small short-hour customers could be advocated scientifically only on the ground that the large number of small consumers by the grace of which the company has the use of the streets and public alleys for the distribution of its current, are entitled to receive compensation in this way for the franchise, and that larger consumers are not entitled to receive compensation in the same proportion. The reports of the various experts employed at Minneapolis taken alone should be sufficient to show any body of city officials that a uniform rate per kw-hour to all consumers is unfair, and that when this issue is brought up for decision by competent authorities, the uniform rate contention is certain to be defeated.

But the Minneapolis case is only the last of a series of important decisions that have been rendered on this subject, all of which have pointed the same way. In the Columbus, Ohio, case of 1906, the electric light rate question was thoroughly investigated by the courts and the principles outlined above were upheld. In Chicago, in 1906, the Arnold and Carroll report on electric lighting rates gave very cold comfort to the advocates of the uniform rate idea.

In the expert arbitration of 1907 on rates for Boston street lighting, the arbitrators at the outset rejected the proposition that the rate for one class of service should be based on the average cost of serving all classes of customers. The position was taken that the rate should be based on the cost of giving the particular kind of service under consideration. The Wisconsin state commission in recently authorizing an increase of electric light and power rates in the city of La Crosse upon advice of its experts, endorsed and authorized the readiness-to-serve system of charging. In Massachusetts, where the electric light commission is of many years standing, Boston furnishes a conspicuous example of a logical rate system based on the investment and operating expenses necessary to serve each individual class of customers rather than on the average expense of serving all. Now comes the Minneapolis case, further establishing the sound principles of rate making. It is not now to be anticipated that in the future any intelligent court or board of arbitration will reverse all of these decisions.

Some important gas and electric interests in this country have expressed fear that the results of the establishment of state electric lighting commissions and of the review of rates by outside authorities would be to abolish the so-called discrimination between different classes of customers and require the establishment of a uniform rate per kw-hour to all. In view of all these cases cited, these fears are entirely unfounded, and it is doubtful if there is a case where either a competent board of expert arbitrators or a state commission has ruled that a uniform rate per kw-hour to all customers was required to prevent discrimination. It has been rather held that it is discrimination against some customers to grant a uniform rate to all, and that the only kind of discrimination which should be abolished in the electric lighting business is that which gives a low rate to a customer who is not by virtue of the character of his load entitled to it.

In addition to the foregoing questions, other things of interest and instruction to the public of Minneapolis have come out of the rate controversy. Prof. Cooley pointed out to the com-

mittee that a limited term franchise costs the consumers more than a perpetual franchise because the company must figure on completely paying off its stock and bondholders at the end of the limited franchise, and this, of course, means higher fixed charges and higher rates than if the franchise were perpetual with proper safeguards. In addition to this, as recently pointed out in an editorial in the Minneapolis *Journal*, a corporation that is not under the menace of having to go out of business at a fixed time can sell its bonds at a lower rate of interest than would be possible if its franchise was for a limited period. It would, for instance, the *Journal* thinks, probably be possible for the Minneapolis General Electric Company to float 4 per cent bonds on a perpetual franchise, whereas with a limited franchise it pays 5 per cent. It points out that Prof. Cooley and other authorities believe in the idea of perpetual franchises, with the public's interests carefully safeguarded, and recommend a clause giving the public the right of purchase at any time after due notice of appraisal. Still another device that makes the perpetual franchise highly desirable is a profit-sharing agreement whereby the city can enter a partnership with the company. This is a prominent feature of the Chicago traction agreement. Such an agreement, which properly looks after both the company and the public interest, should be far preferable to many of the uncertainties attending public service franchises at the present time.

Engineering Education.

At a special meeting of the American Institute of Electrical Engineers, held under the auspices of the educational committee on Jan. 24, two papers were presented on the subject of engineering education. A paper by Dr. C. P. Steinmetz contained criticisms of the important defects in present educational methods for the purpose of urging their elimination. This paper is reproduced elsewhere in this issue.

A paper by Mr. Chas. F. Scott was in reality an introduction to a digest prepared by Prof. H. H. Norris of the papers on engineering education that have been presented before the American Institute of Electrical Engineers during the past 16 years. Mr. Scott stated that the problem of arranging an engineering course is largely one of elimination, because, if all of the studies were included which have been suggested as essential or desirable in the training of a student, the college period of four years would have to be increased to possibly 20 or 30 years. In the arrangement of subjects and courses, the following questions arise: (1) The relative attention to be given to the practical or industrial, the scientific, and the cultural. (2) The relative proportion between subjects which are valuable for imparting technical knowledge and those affording training in scientific and logical methods. (3) The relation between school instruction and practical work; whether one should precede the other, and if so which one should come first, or whether they should alternate. (4) The importance of current engineering practice; of lectures by practicing engineers; of discussion of current topics in local meetings of the Institute. (5) The degree of desirable differentiation in courses or methods on account of differences in the characteristics of individual students or in the fields of work they expect to enter. (7) The sequence of subjects—whether the theoretical groundwork should be laid during the first few years and the practical subjects reserved until the latter part of the course, or whether an intermingling of the two in accordance with the concentric method outlined by Prof. V. Karapetoff at the 1907 convention is to be preferred. Mr. Scott expressed the opinion that although the concentric method clashes with time-honored educational ideals, it presents arguments which are so rational that the existing method must assume the defensive.

In abstracting his own paper Dr. Steinmetz said that while mathematics is the most important tool of an engineer, it is useful and valuable only as long as it is employed as a tool, and ceases to be useful as soon as it becomes a purpose. It is merely a shorthand method of recording physical intuition and physical reasoning. It becomes positively dangerous when the one using it does not fully see the physical meaning of every mathematical step. In dealing with mathematics it must be recognized that it is only an empty formalism to one who does not realize its purpose as a tool.

DISCUSSION.

A communication by Mr. L. A. Osborne was read by Prof. H. H. Norris. Mr. Osborne expressed the opinion that 50 per cent of the technical graduates that present themselves to be employed might better never have undertaken their profession. He stated that engineers to-day are too self-centered; too bound up in details of their profession. Their perspective is too narrow, largely because their early training did not stimulate them in the right direction. There should be injected into the engineering courses something that will stimulate the powers of generalization.

Prof. H. E. Clifford remarked that an attempt to broaden the training may result in a tendency to standardize education, and standardization cannot be applied to educational methods. A distinct step forward will be taken if an attempt is made to eliminate from the student body those men who lack ability for their chosen line of work.

Prof. F. B. Crocker said that the proposed concentric method of teaching engineering possesses at least one almost fatal difficulty in that it would not tend to eliminate the students who are unfitted to become engineers.

Mr. H. W. Buck contended that in the development of engineering science the physical action must be clearly pictured before the theoretical treatment can be intelligently pursued. When practical applications are not made of mathematical equations the mind of the student becomes filled with a maze of symbolic relations, and a proper conception of what mathematics is for is lost.

Prof. W. S. Franklin said that the curriculum of a technical school should be so planned that the student covers the subjects of physics and chemistry in a comparatively brief course with the idea of accentuating the really fundamental things, and then this course should be followed by more elaborate courses in technology.

Mr. L. B. Stillwell expressed the opinion that in nine out of ten cases mere professional information acquired in the technical school is of comparatively little value to the graduate. The ideal education of the engineer who hopes to be more than a private in the ranks is a broad one. It cannot very well be too broad. Whenever possible a technical course leading to a degree in engineering should follow a four years' course leading to the degree of Bachelor of Arts, or Bachelor of Science. In other words, engineering courses should be regarded as professional courses and should perform the same function in the education of the engineer that the law school fulfills in equipping a graduate in the course of arts for the practice of law. The men who rise highest in the engineering profession, generally speaking, are the men of broader education. Chief engineers and managers have little trouble in finding draftsmen and less in finding competent calculators, but the demand for "all around men" always exceeds the supply.

Prof. Albert F. Ganz said that the college should teach those things which the engineer must know and which he cannot readily obtain in practice.

Mr. J. G. White stated his belief that the college professor is too much inclined to go to lectures and too little inclined to depend on well-planned text books. The students' time should not be wasted in making notes and going through the mechanical operation of copying them without understanding the subject. There should be fewer text-books, fewer elective studies, and the studies should be confined to particular studies rather than to general information.

Prof. W. E. S. Temple called attention to the fact that no hard and fast rule can be made as to lectures, because the rapid progress now being made in electrical engineering demands that certain subjects be taken up in lectures. However, preliminary features should be taught by means of text-books.

Mr. L. A. Ferguson said that a premium should be placed upon the development of reasoning power rather than the mere memory of the student, and any subjects that he must know in his practice after graduation should be kept constantly before him throughout the entire course, so that he may carry his knowledge, once acquired, with him into the world. In order to prevent narrowness of view and mental fatigue among the teachers, the faculty of an engineering college should be made up of men graduated from as wide a range of colleges as possible.

Dr. Samuel Sheldon remarked that the advantages which are claimed for the concentric method of teaching should be obtained if possible. However, the method of accomplishing the object need not be so radical as the one proposed by Professor Karapetoff. For example, the physical laboratory work can be laid out so as to constitute a course in experimental electrical engineering.

Mr. Percy H. Thomas said that during the college course time should be spent on things that cannot be learned later, but not on subjects such as commercial designs of apparatus, constants of design and the relative merits of different makes.

Prof. W. L. Robb called attention to the relative lack of preparation of men who enter technical schools. Under the present condition of things, culture subjects have a place in a technical school, but they have only a transient place, because a course in English or history or political economy has no more place in a technical school than in a medical college or law college. The entrance requirements of technical schools should be brought up to the entrance requirements of the latter colleges.

Mr. C. O. Mailloux, in discussing the relative merits of lectures and text-books, said that the ideal method is to combine the two. The text books should be small, and should cover few points but cover them thoroughly. The student should not be required to take notes except when absolutely necessary. More use should be made of applied mathematics and less of pure mathematics.

Prof. D. C. Jackson said that it is better to carry general studies throughout a man's college career than to carry them to a certain point and chop them off and start a new line of education.

President H. G. Stott thought that a cure for many of the present ills will be found in raising the standard of entrance examinations, and teaching fundamental principles and not engineering practice.

Mr. C. F. Scott expressed the opinion that the concentric method is to be commended rather than objected to, because it is logical and psychological.

Dr. Steinmetz said that he thoroughly believes in Professor Karapetoff's concentric method. It is somewhat disadvantageous, however, in that a student who goes over a subject first in a practical way and then goes over the same subject theoretically and more thoroughly, is liable to neglect it and think he knows enough about it. A large part of the defects of the present college education are really defects inherited by the college from the high school and the primary school, and there is where the lever must be applied to improve conditions.

The State Right to Fix Lighting Rates.

Last week hearings were had at Albany, N. Y., in the appeal of the Saratoga Gas, Electric Light & Power Company against the order of the old Gas and Electric Commission fixing certain rates for gas and electricity. The case is considered as a most important one by lighting interests, the order having been supported in the lower court by a vote of three to two. The argument of the lighting company that the order in question was void, falls into two divisions: First, that Chapter 737 of the Laws of 1905 (creating the Gas Commission), taken as a whole, presents a legislative plan and is based upon principles essentially unconstitutional. It is therefore wholly void. Second, that Section 17 of this act, and its complementary section, 19, are unconstitutional and are therefore no authority for the order appealed from.

The attorneys for the company contended under the first head that:

First—The practical and underlying purpose of the act is to transfer to a non-elective body of three, not a local agency of government and not mentioned in the constitution, substantially all the police powers of the state and all the legislative discretion and functions of the Legislature, with respect to the control, management and restriction of the business of supplying gas and electricity, whether conducted by individuals or corporations.

Second—An essential part of the theory of the act is the delegation to the judiciary of non-judicial powers as to the details of the gas and electric government and restriction and the fixing of maximum rates of sale.

Third—One of the integral designs and effects of the act is to prevent, without compensation or due process of law, individuals and corporations engaged in the gas and electric business from exercising some of the most essential and valuable rights of property.

The points under the second head were as follows:

First—The power delegated to the commission to fix maximum rates is, in so far as it relates to the village of Saratoga Springs, a legislative and not a judicial, administrative or ministerial power.

Second—An essential part of the design of the Legislature in delegating to the commission the power to fix rates was to direct not only a review by the Appellate Division of the decision of the commission, but also the substitution of the discretion of the Appellate Division for that of the commission.

Third—By authorizing the commission, when fixing rates or ordering improvements in the methods, manufacture, transmission of supply, to proceed upon the ex parte investigation of its members, officers, agents or inspectors, Section 17 deprives those engaged in the gas and electric business of their property without due process of law.

Fourth—By depriving individuals and corporations engaged in the gas or electric business of the right to apply for an alteration of a rate once fixed by the commission, while conceding this important privilege to their opponents, Section 17 denies to them the equal protection of the laws.

In enlarging upon these points the attorneys declared: We say without hesitancy that the gas commission law of 1905 has brought this court squarely to the parting of the ways in the matter of government by commission. If the Legislature can delegate to a body not mentioned in the constitution absolute and unrestricted powers as to gas and electricity, it can do so to every other industrial occupation or business affected with a public use.

It can thus practically abdicate its own most important functions, and instead of having one Legislature sitting at Albany, the state may in fact have a hundred different legislatures, each a non-elective body not directly responsible to the people, and each wielding the full police power of the state over the particular occupation committed to its control, and each, under the guise of rules and orders, passing such laws and adopting such policies as may seem to it good.

The act is an unprecedented experiment in state socialism, and the next logical step is the open assumption by the state of paternal power over all the attributes of private property invested in these industries—namely, the legal taking of such property without compensation.

This court therefore should deliberate long and earnestly before upholding the novel principle represented in the gas commission law, which, however popular for the time being, is in reality part of a bureaucratic and not of a democratic system of government, and may lead to infinite mischief in the future.

This is government ownership without the burdensome detail of paying for the property.

After going into the various points raised by counsel for the gas company, Deputy Attorney General Decker said: This

is the first proceeding, under this statute to reach this court. It is believed that no public regulation of rates has ever been annulled in a special proceeding such as this. No precedent for annulling such public action should be established on a record like this, which fails to raise a reasonable suspicion that the rates in this case are unfair to the appellant. The act of fixing rates to govern in the future is in its very nature experimental. When a commission after a painstaking investigation has fixed rates on their face reasonable the public servants should be relegated to a suit or defence wherein the court asked to annul rates as confiscatory may have the solid ground of proved experience before visiting its condemnation on action taken under legislative authority within the admitted sphere of legislative jurisdiction. While the statute under consideration has been repealed, the special attention of this court is invited to the importance of this case as the precursor of attacks upon the validity of the public service commissions law, undoubtedly to follow.

Report of the New York Up-State Commission.

The Public Service Commission of New York State, for the second or up-state district, has just filed its first annual report to the Legislature. It deals almost entirely with traction and transportation questions. It has regulation over railroad properties capitalized at over $2,000,000,000, and lighting properties, gas and electricity approximating $500,000,000. In its review of work done in the lighting field, the report says: "The commission is engaged in the inspection of electric meters upon consumers' complaints and the inspection of testing systems at electric stations. The testing of all meters furnished to consumers has not been undertaken. The commission, after thorough investigation, is convinced that the tendency of electric meters is to under-register. The intent of the law is undoubtedly that no electric meter shall be furnished for use, or having been furnished, shall remain in use, without bearing the seal of the commission guaranteeing its correct registration. The destruction of such stamp, if a seal, would require the meter to be again submitted for verification. The difficulties attending the actual testing and sealing of all consumers' electric meters in the state are stated, and the report of a committee of representatives of the electric companies in the state is set forth under this heading. Six tests of consumers' meters upon complaint have been made in six cases.

The commission states that it will insist on the keeping of a depreciation account relating to all classes of lighting property.

Indiana Engineering Society Report on New Illuminants.

During the meeting of the Indiana Engineering Society, held Jan. 16, 17, 18 and 19, the committee on central station light, heat and power, of which Mr. J. B. Nelson was chairman, presented a report dealing with the relation of central stations to the high-efficiency illuminants. The committee held that the introduction of the new lamps will be slow so long as the present high prices are maintained. The central station man has been unable to bring himself to believe that he is under moral obligation to advise his patrons to install the high-efficiency lamps, thereby reducing his income, while the less energy cost to the consumer is counterbalanced by the additional cost of the new lamps.

According to the retail prices set by the Association of Lamp Manufacturers, a 16-cp, 56-watt, carbon-filament lamp is listed at 20 cts.; a 20-cp, 50-watt, graphitized-filament lamp is listed at 25 cts.; a 20-cp, 40-watt, tantalum-filament lamp is listed at 60 cts.; a 32-cp, 40-watt, tungsten-filament lamp is listed at $1.50. Since the metal tungsten is not rarer or more valuable than the metal tantalum, Mr. Nelson expressed the opinion that the cost of manufacture of the tungsten lamp is not appreciably greater than that of the tantalum lamp. The future general use of the tungsten lamp will depend upon a material reduction in the present price.

High-Efficiency Lamps in Kaiserslautern, Germany.

By L. J. Auerbacher.

The town of Kaiserslautern, Germany, with a population of 55,000, has its principal streets lighted by alternating-current flaming lamps and with excellent results. The lamps are so suspended from cables as to hang in the middle of the street and are swung 30 ft. high and from 150 ft. to 300 ft. apart. The illumination even at these long distances apart is excellent. The lamps take 650 watts each. The cost for a year of 3000 hours is stated to be $90. Coal is $3.50 per ton, but labor is very cheap, firemen receiving $1 per day, engineers $2 per day, and the general superintendent $1,100 per year.

The alternating-current flaming arc is found to work best with an initial voltage of 65 volts and a resistance to cut this down to 55 volts at the arc. With only 55 volts at the terminals much unsteadiness is caused. They are also operated well two in series on 110 to 120 volt circuits.

The plant, which is a municipal one, is in competition with a gas plant owned by private capital, which installs the latest type of inverted gas burners free of charge to customers. To meet this competition the electric people use the Osram lamp of 50 hefners (45 candle-power), and use also many 100 hefner (90 candle-power) frosted. Their load is now fully one-third Osram lamp. The lamps are sold to the customers at 87 cents for the 50 hefner and $1.25 for the 100 hefner, which includes a profit of 25 per cent. Experience with this lamp has been very satisfactory. The factory replaces lamps received in a damaged condition. The percentage of breakage is less than 5 per cent. If the lamp burns well for 50 hours, it is found that the life will continue to 800 or 1000 hours. Lamps that are blackened within 50 hours are replaced free of charge; discoloration is due to the material in the joint where the filament is made fast to the leading-in wires. The charge for electrical energy is 7½ cents per kw-hour for the first 300 hours, and 2½ cents thereafter. The rates for power and light are identical. About 700 kilowatts in motors and 1800 kilowatts in lights are connected.

The Just wolfram lamp is also very largely used. They are now made for 16 hefners for 110 volts, and also 50 hefners for 220 volts. The factory replaces breakage, and their use is very general. As yet very few of the illuminating companies furnish free high-efficiency lamp renewals. The Strassburg plant is an exception, as it not only furnishes free tungsten lamp renewals, but wires up free provided a three-years' contract for current is made. The Strassburg company, which pays good dividends, is noted for its progressiveness.

Consumers are getting used to the larger illuminating unit of the metallic-filament lamp and the old 16 candle-power is falling into disfavor. In Paris the few stores without the high-candle-power tantalum lamp look as though they were out of business. The large sewing-machine factory of G. M. Pfaff, at Kaiserslautern, uses 220-volt Just wolfram lamps and also Nernst lamps and flaming arcs. There are no low-efficiency lamps of any kind in the factory, which also employs the electric drive exclusively.

Municipal Lighting Conditions in Massachusetts.

A letter to the editor of one of the suburban papers near Boston is of particular interest in regard to municipal ownership. This letter is as follows: "Mr. Editor: I would suggest to the present committee on street electric light equipment that they have a clause inserted providing that respectable, straight poles be put in various parts of the town and painted as in other towns and that the poles be put in so as to do as little

damage as possible to private property. Also that these poles and wires shall be placed with especial regard for the trees."

The interesting point about this is that the town owns its own street lighting system and the majority of the poles. The Boston Edison Company has a transmission line through the town and supplies a few commercial customers and also supplies electrical energy to the street lighting distribution system. Outside of the transmission line more than three-fourths of the poles belong to the town.

The town has recently voted to sell its distribution system to the company and hereafter to have the Edison Company do the distribution of the street lights as well as supply the current. So long as the town owned the poles, the citizens were satisfied with comparatively poor service, but the moment a private company is to become responsible, the town demands far better service than it has ever demanded from its own lighting board.

The case is similar in another town near Boston, which ran without any reserve and whenever a breakdown occurred let one-half the town have current Monday, Wednesday and Friday and the other half Tuesday, Thursday and Saturday; or, in another town in Massachusetts, which ran without even sufficient capacity to carry the load and managed to pull through by never putting on the street lights until after the stores had closed. The price per lamp is not the only criterion. The quality of service has a great deal to do with the cost.

Depreciation.

Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company, and for many years a prominent figure in American street railway accounting matters, read an important paper before the Northwestern Electrical Association, at Milwaukee, Jan. 15, on the depreciation of electric lighting properties. Some extracts from this timely statement follow, together with an abstract of the discussion which it brought out:

The Public Utility Law of Wisconsin provides that "Every public utility shall carry a proper and adequate depreciation account whenever the commission after investigation shall determine that such depreciation account can be reasonably required. The commission shall ascertain and determine what are the proper and adequate rates of depreciation of the several classes of property of each public utility. The rates shall be such as will provide the amounts required over and above the expense of maintenance, to keep such property in a state of efficiency corresponding to the progress of the industry. Each public utility shall conform its depreciation accounts to such rates so ascertained and determined by the commission. The commission may make changes in such rates of depreciation from time to time as it may find to be necessary."

For the purpose of the paper "depreciation" was defined as a "lessening of value," and the treatment of the subject confined to broad general questions, briefly touched upon, as applicable to the electric lighting business.

This "lessening of value" may be brought about, in so far as the physical property is concerned, from the following causes:

(1) Deterioration due to the ravages of time and the effects of the elements. (2) Wear and tear incident to use. (3) Displacement by reason of obsolescence or supercession, resulting from the development of the art or the evolution of the business.

The determination of the measure of depreciation necessary to provide, by reason of "deterioration" and "wear and tear," can possibly, with some degree of accuracy and satisfaction, be arrived at; the effects of obsolescence and supersession, practically unknown quantities, judging by the history of the past, presents a most complex question of the greatest importance and most far reaching in its consequences.

Broadly speaking, the most correct and sound method to pursue would be to arrive at the estimated average life of the different kinds of physical property dealt with, determining this life on the basis of type, methods of construction and installation, as well as the character and extent of its use and the conditions under which it is used.

The different kinds of physical property of an electric lighting system to be dealt with, in considering "depreciation," may be broadly classified as follows:

(1) Buildings and fixtures.
(2) Generating station equipment.
(3) Transmission system.
(4) Sub-station equipment.
(5) Distribution system.
(6) Transformer installation.
(7) Meter installation.
(8) Lamp installation.
(9) Tools and appliances.
(10) Miscellaneous equipment.

The measure of "depreciation" to be provided for, as finally determined on the basis previously outlined and suggested, reduced to or expressed in dollars and cents, and worked out in detail for each class of physical property, on the kw-hour unit, should be taken up in the accounts monthly. This may be done, as a matter of detail, by one of the following methods:

(1) "Operating expenses," in the appropriate accounts, should be debited and "depreciation reserve" credited, with the monthly proportion of the total annual "depreciation charge," based on the kw-hours unit cost.

(2) The monthly proportion of the total annual "depreciation charge," based on the kw-hour unit cost, could be treated as a deduction from the "net earnings from operation," and the amount so deducted credited to "depreciation reserve."

(3) The monthly proportion of the total annual "depreciation charge" (regardless of what the charge may be, based on the kw-hour unit cost), could be treated as a deduction from "net earnings from operation," based on the percentage said charge bears to the estimated "gross earnings," for the year and the amount so deducted credited to "depreciation reserve."

If the "depreciation reserve" so created is to be something more than a mere "bookkeeping" reserve, and the amounts thus set aside actually invested in interest-bearing securities, the interest earned on such securities should be credited to "depreciation reserve."

It should be understood, of course, that when replacements and renewals of physical property are made, the cost should be charged against "depreciation reserve."

If the first method suggested is followed, the "depreciation charge" introduced in "operating expenses" should be specifically stated and shown in the appropriate "operating expense accounts." If this is not done, there will be no way of showing "ordinary maintenance charges" separate and distinct from "depreciation charges," and "operating expenses" will not clearly show actual results.

Unquestionably, the first method proposed is more rational than the second or third, but the two latter will be found easier to work out and apply.

Either of the three suggested will accomplish the same results, in so far as ascertaining, on the same basis, what the "net income" is, applicable to "return on investment." The "measure of depreciation to be provided for" is the vital question; the method of its application, if sound and correct, is of secondary importance.

The Milwaukee Electric Railway & Light Company has, since Jan. 1, 1898, down to the present date, followed the third method suggested. Mr. John I. Beggs, president and general manager of our company, is a pioneer in recognizing and providing for "depreciation." He not only had the wisdom and foresight ten years ago to recognize "depreciation," but the courage of his convictions, in the administration of the property, to carry out the policy of providing for it in the accounts and finances.

AMORTIZATION.

In addition to providing for "depreciation," as previously defined and treated, provision should be made for a shrinkage in the value of the physical property, if, through necessity, it is disposed of as junk or scrap at the expiration of limited-term

franchises. The amortization of capital liabilities, for which there may be no tangible assets, should also be provided for, or sufficient "return on investment" be assured to justify capital assuming the risks attendant on the business.

"Depreciation" and "amortization" must be reckoned with in determining the cost of furnishing electric current, together with interest on investment, as well as the cost of generation and regeneration, the cost of distribution, the general expenses incident to the conduct of the business, and taxes. Indeed, to this cost should be added adequate charges to cover reserves for unliquidated damage claims and provision for contingencies before the true cost of electric current delivered to the consumer can be fully and absolutely determined.

The subtraction of ordinary or current "operating expenses" and "taxes" from "gross earnings" does not represent "net earnings" available either for interest on bonds or dividends on stocks. It is high time that the electric lighting interests of the country awakened to the full realization of this very important fact.

In the discussion of Mr. Duffy's paper, Mr. W. B. Jackson was asked to make a statement as to the methods of figuring depreciation used by him and his associates in the recent appraisal of the property of the Minneapolis General Electric Company. He said that after very careful consideration they came to the conclusion that a fair duplication value of the property would probably give the most simple method of arriving at a figure upon which fair investment charges for electric light and power could be based. This was done because it was concluded that the depreciated value of a plant would of necessity come to a figure somewhere between 70 and 80 per cent of its original value, because if the value had been permitted to drop below about 70 per cent of the cost of duplicating the plant, the plant would probably have been allowed to run down to a point that it could not give fair and reliable service to the city. It was, therefore, decided to take the cost of duplicating the plant, less a certain amount of depreciation, and add to it that value of any property which is inherent in it as a growing concern; that is, the value which is due to the fact that the business has been worked up from nothing to that of an efficient and reliable organization where the company is doing business well and economically. They arrived at the conclusion that a figure of 2.9 to 3 per cent per annum should be allowed for depreciation upon the duplicate value of the entire property, including land and water power. This depreciation figure would be higher if only figured on the operating features of the plant. The only fair way to arrive at the year's depreciation for this property was to take each of the different factors separately.

Mr. P. H. Korst, of Janesville, Wis., said that his company had attempted to take care of depreciation by charging all improvements of the plant of whatever nature to an improvement account. At the end of the year a committee is appointed by the directors to go over this improvement account and decide what proportion of each item should be charged to depreciation. In some cases the improvement account would be wiped out by the depreciation allowed.

Mr. J. H. Harding, of La Porte, Ind., said his company's practice was to charge to stock all materials bought and from there they are charged to renewal of plant or to plant extension, as the case might be. In the case of replacing an old generator with a new, the amount received for the old generator was deducted from the cost of the new generator, and part is charged to expense account and the balance to plant account. No fund is set aside especially for depreciation.

Mr. Jackson explained further in connection with the Minneapolis appraisal that in getting the depreciation value they figured the different parts of the plant as being construction by sub-contractors. Then they added a percentage for engineering and general contracting work, and also half of 1 per cent of the cost of the entire construction for insurance. They added a percentage for law organization and general incidental expenses, and also 6 per cent on the value of the plant for one year, and 8 per cent for the cost of selling or disposing of the securities. The figures upon which they based their final estimate, therefore, gave all of the several items that must enter into getting such a plant going.

Mr. R. N. Kimball, of Kenosha, raised the question whether if a company originally did not make a charge to depreciation account the state commission in considering applications for reduction of rates would make an allowance for depreciation, even though the company had not in the first years of its existence kept its books so as to recognize depreciation. For example, his company had originally put down any excess over interest and operating expenses as surplus. Part of this surplus was, of course, really depreciation. Out of this surplus money had been put back into the plant from time to time which had taken care of what we would now call depreciation, but which at that time the company did not call by that name. He asked whether the Wisconsin commission in any of the cases so far decided had given an expression of its opinion on the items of depreciation on different classes of apparatus or whether any decisions recognizing depreciation had been rendered thus far.

Mr. Duffy said that the Wisconsin commission had recognized the principle of depreciation in a decision on the application of the Merrill Railway & Lighting Company for authority to change its rate for electric lighting. Mr. Duffy said we should not be carried away with bookkeeping methods. We must recognize the principle and apply the principle as it should be applied. There is no justification for depreciation being at one time treated as surplus and at another time some other way. For instance, if you are going to charge the difference between a displaced generator at its value when displaced and the cost of a new generator as depreciation, he would like to ask what became of the operating expenses during the month or year when it stood that abnormal charge. He wished to say for the state of Wisconsin and for the railroad commission that they not only recognized the principle of depreciation, but they applied it in a just and equitable way. In the electric lighting business it is difficult to draw the line between repairs and replacement.

For example, a company would have to replace a pole now and then, or a wire, or a meter, or a transformer. This ought to be dealt with liberally, and, to his mind, was maintenance, but there would come a time when the company would have to lift out 100 poles or take down miles of wire, notwithstanding these current ordinary repairs and these incidental replacements. If you have not recognized that and provided for it by taking out of the surplus such a sum as is necessary to replace that property, you have certainly made a mistake. In two specific cases in Massachusetts, with the consent and approval of the railroad commissioners, the fare was raised from 10 cents to 12 cents on an interurban railway. The cost of operation and taxes subtracted from gross earnings never makes interest applicable on bonds and surplus. The one who does not set aside a sufficient sum to take care of depreciation, but charges these expenses direct to operation, attains the same results, but attains it at the expense of upsetting his correct results for that month, which is unfair to that month and to that year. Answering the question as to whether the Wisconsin commission had recognized depreciation, he quoted from the Merrill Railway & Lighting Company decision as follows:

"To the above expenses should be added something to the depreciation and interest on the investment." The applicant places the depreciation at about 6 per cent on the total value of the plant. Good engineers place it at from 3 to 10 per cent. The former figure is, perhaps, too low and the latter too high. It is quite probable that it should be placed above 5 per cent. While depreciation is figured at a certain per cent per year during the life of the property, it is undoubtedly increasing with the age of the same.

The rate of interest that should be allowed on the investment in such plants is also a matter that has not been definitely fixed. By many authorities it is placed at from 6 to 8 per cent, and by others again as high as 10 to 15 per cent on the cost of the plant. Those who invest their money in undertakings of this character are undoubtedly entitled to interest at the current

rates, and possibly something besides, to cover risks and contingencies.

Mr. Duffy said one of these contingencies is the obsolescence that he spoke of in his paper. In addition to other things, there can be strikes, fires, etc. These are contingencies. Unless these are allowed for, investors would not be likely to put their money into such plants. He then quoted further from the Merrill decision, showing the position of the commission with reference to depreciation.

Mr. Neal Brown urged that if the principle established in the Merrill case that "reasonable profits" should be an ordinary interest-bearing rate and possibly something more, it will not be very encouraging to investors. If the railroad commission should establish a rule that practically the interest-bearing rate of money should be the measure of profit, one could never develop an electric light and power property. Men who go into manufacturing or make loans on farm property for 6 or 7 per cent would not invest their money with the well known hazards that may come to a public service corporation. The state does not guarantee the investor 5, 6 or 7 per cent if the company loses, but, on the other hand, the intimation has been made that the legal interest will be the practical limit on the investment. However, he thought the railroad commission to be made up of very fair-minded men, and if the matter ever came before them fairly, they would decide correctly and they would hold that men engaged in pioneer development work should not be placed, with respect to their investments, on a common interest-bearing basis. The term "reasonable profit" is one that is relative. There are manufacturing interests in Wisconsin that have been making from 25 to 100 per cent profit during the last 25 years. The term "reasonable" should be interpreted and construed with reference to the surrounding business conditions. He had in mind a water-power plant that he had been interested in where $100,000 had been invested in purchasing the lands necessary, to say nothing of the development of the power. If he had said to his associates when he went to them to get money to buy up this land, "Well, you will be cut down to a 6 per cent interest basis if you develop that power," they would not have put a dollar into it.

Mr. W. R. Putnam, chairman, suggested that there was one difference between the public service and a manufacturing business in that in one sense of the word the people are in partnership with the companies. They grant certain rights in giving franchises which the ordinary manufacturing corporation has not, and in return for those rights the companies must take them into consideration in figuring what a reasonable profit is. Mr. Brown said that this was a proper inquiry, but the position was not well taken. He said, "You say we enjoy these great privileges. Well, some of us enjoy them and some do not. I have not had any great enjoyment out of the franchises and privileges that I have had."

Meeting of the Pittsburg Section of the A. I. E. E.

The Pittsburg Section of the American Institute of Electrical Engineers met Wednesday, Jan. 8, 1908, in the Carnegie Institute Lecture Hall, for the purpose of discussing "Illumination." One of the principal papers of the evening was given by Arthur J. Sweet, of the Westinghouse Lamp Company, of Newark, N. J. Mr. Sweet first reviewed the theoretical factors of good illumination, classifying them under the following subjects: Efficiency of illumination, intrinsic brilliancy of light source, color, intensity, steadiness and efficiency of light distribution, size of illuminating source and the temperature to which it is possible to raise the incandescent solid. All these subjects have to be studied by the illuminating engineer in order to understand the physiological process of good visual perception. Visual perception is the thing to be considered more than candle-powers. The visual perception of an object lighted with an illumination of two foot-candles is very different when the field of vision is surrounded by intense light than when surrounded by a soft, weak light. In other words, very light reflecting walls should not be highly illuminated from a small, intense light source, but from a larger light source of lower intensity.

Different colored papers absorb different amounts of light, and that which is absorbed is lost. The percentages of light reflected by different colored papers are: White, 80; orange, 50; yellow, 40; light pink, 35; light blue, 25; emerald green, 18; dark brown, 10.

The following table gives a comparison of the physical properties of the most common forms of electric lamps:

Kind of Lamp.	Mean spherical candle power.	Watts per candle.	Candles per kw.
Common 56-watt carbon-filament incandescent lamp, rated at 3.5 watts per candle, 16 horizontal candle power	13.2	4.24	236
Common 50-watt carbon-filament incandescent lamp, rated at 3.1 watts per candle, 16 horizontal candle power	13.2	3.78	264
Three-glower, 264-watt Nernst lamp	81.	3.26	307
Gem, 125-watt, graphitized-carbon-filament lamp of 50 horizontal candle power	40.7	3.07	326
44-watt tantalum lamp, rated at 22 horizontal candle power	16.0	2.75	364
Direct-current 5.1-ampere enclosed-arc on 110-volt circuit, 1.5-in. carbons	213.0	2.63	380
Alternating-current enclosed 5.7-amp. arc, taking 388 watts on 110-volt circuit, .5-in. carbons	152.0	2.55	392
60-watt, 110-volt tungsten-filament, lamp burning at 1.25 watts per horizontal candle	37.0	1.62	617
Luminous 8-amp. arc, 440-watt, two in series on 110-volt circuit	1020.0	.431	2320

Mr. Sweet stated that the filaments of tungsten lamps are now spring-anchored, and the lamps can be used in any position. He said that a tungsten lamp can be operated at double voltage for over an hour without burning out, while a carbon-filament lamp would last only a few seconds.

Mr. G. M. Little, of the Westinghouse Electric & Manufacturing Company, gave a very clear description of the art of making arc lamp electrodes, from the Jablokoff candle down to the latest flaming arc and magnetite lamps, illustrating his talk with lantern slides. He said that when the enclosed arc came into vogue carbon manufacturers feared that the arc lamp designer might go a step farther and enclose the electrodes in a vacuum, which would make them last indefinitely. However, when the experiment was tried it was found than an arc could not be supported in a vacuum and there was joy in the camp of the carbon manufacturers once more. Arc lamps are now made with a specific consumption of .2 watt per candle. The manufacture of electrodes has been gradually perfected through a great many more difficulties than are generally known. Many different kinds of coke and mixtures of coke and lamp black were tried and analyzed, and refinements were made, even down to extracting small quantities of iron impurities which made the carbons magnetic and blew the arc to one side.

Mr. George Loring, engineer of the National Electric Lamp Association of Cleveland, Ohio, gave an impromptu talk on the latest development of the tungsten lamp, and remarked that they can now be shipped without danger of breaking. He also called attention to the improvement in the quality of light delivered by a tungsten lamp over that of the ordinary carbon-filament lamp. The tungsten lamp gives a light closely resembling sunlight, while the carbon-filament lamp light corresponds with that given by the spectrum from the green down. A variation in e. m. f. above or below the rated normal does not make such a variation in the light emitted from the tantalum as it does with that emitted from the carbon-filament lamp. The 32-cp, 40-watt, 110-volt tantalum lamp is now a commercial article, and appears to be well suited for general needs. Mr. Loring stated that it is a mistake to assume that the use of the tantalum lamp will cause a reduction in the receipts of the central station. It is the present poor light obtained from the carbon-filament lamps that has caused many people to use Welsbach lamps when they would prefer electric lamps. Moreover, the cheapening of anything makes its use much more general. Thus the customer will not be as anxious as formerly to turn off the light as soon as possible, and more lamps will be used for advertising.

Mr. Skinner called attention to tests made by the Allegheny

County Light Company, which found that its customers were using old lamps that were originally rated at 16 cp, but had deteriorated so that some of them did not give more than 6 cp.

A letter was read from Mr. A. J. Wurts, who was confined at home on account of illness. He made the suggestion that all lamps should have two ratings—a photometer rating and an illuminating power rating. The latter should be based on the well-known 16-cp lamp as a unit.

Mr. Martin, of the Allegheny County Light Company, read a short discussion on lighting, prepared by Mr. Muller. The principal points brought out were that the central station man is now deriving a good income from electric heaters, small motors, etc., in addition to lamps. He gave a table comparing the renewal cost with the consumption of all the different styles of incandescent lamps on the market.

Gas and Electric Consolidation in Massachusetts.

The subject of the consolidation of gas and electric properties is considered in a report of the Board of Gas and Electric Commissioners of Massachusetts to the State House of Representatives, following an investigation made at the direction of the General Court.

Relative to the acquirement of companies by the Edison Electric Illumination Company, of Boston, the board says: "By its decision in Evans vs. Boston Heating Company, the Supreme Court held that a heating company might mortgage its property. * * * Assuming that if a corporation may mortgage, it may also sell its property, it has been contended that an electric light company may purchase the property of another electric light company and obtain in its own behalf from the proper public authorities locations for the street structures so purchased. Acting upon this theory of its rights, the Edison Electric Illuminating Company, of Boston, has acquired the property and under locations duly obtained therefor where necessary is supplying electricity in the several territories formerly served by the Milton, Dedham, Blue Hill, Natick, Framingham, Woburn, Somerville, Greendale, Medfield, Medway, Church Green, and D. S. McDonald companies."

The board says instances of virtual consolidation, in which two or more gas or electric light companies occupying adjoining territories have been brought under a common control, are increasing in number. They exhibit, both as to financing and as to physical relation of the respective plants involved, many of the features of actual consolidations without the direct and positive advantages to consumers which should result from such actual consolidations as are in the public interest.

From the facts disclosed by its investigation, the board reaches the following conclusions:

That any proposed consolidation will present a situation differing in some degree at least from those which have previously received the sanction of the Legislature or of the board or official to which this discretion may be delegated.

That there is an undoubted opportunity for advantage both in economy of investment and operation and in efficiency in favor of a large gas or electric light plant to serve a given territory over several small plants serving different sections of the same territory. The facts suggest not only the probability of further consolidation of lighting companies, but also the desirability of some such consolidations as in the public interest. It is important, however, in the opinion of the board, that the general policy of the Legislature in regard to them shall be clearly defined.

That if the legal theory under which the Edison Company has acquired other companies is correct, there seems to be no substantial reason why an electric company may not on the same theory purchase the property of a gas company. Furthermore, if the prohibition of the act of 1886 applies to the transfer of the franchise of a gas company and not to its property, the same legal theory might enable one gas company to buy the property of another and thus virtually to consolidate. In either case, no public official or board passes upon the advisability in the public interest of such purchases and sales as a condition precedent to their validity.

The board is of the opinion that, unless the authority to pass upon the advisability of such consolidations is to be retained by the Legislature, it should be delegated to the board, so that no consolidation shall be valid until the board has first decided that it is consistent with the public interest. The board is also of the opinion that this question is of so much importance to the stockholders of the respective corporations involved that such purchase and sale or consolidation shall not be authorized by the vote of a majority only, as it may be under the present practice, but upon a vote of two-thirds in interest of the stockholders of each corporation interested.

The board submits with its report a draft of a bill which it recommends, entitled "an act to authorize the purchase, sale and consolidation of gas and electric light companies."

Cazin Metallic-Filament Incandescent-Lamp Patents.

Three patents were issued Jan. 24 to Francis M. F. Cazin on methods of manufacture of the type of incandescent lamp filaments on which he has previously been granted a number of patents. One of the specifications cites a long line of patents covering the work of Mr. Cazin in the use of the rare metal oxides for incandescent lamps. The earliest of these patents was granted in 1892, and additions to the list were made almost yearly to date. The present patents relate more particularly to details of the manufacture of filaments for incandescent lamps.

In one of the specifications the filament is described as consisting of four separate elements, as follows: 1. A core for electrolytic deposition, preferably of carbon, and of the shape of the finished lamp filament. 2. An electrolytically deposited coat on such core. 3. A second electrolytic coat of metal, the oxygen or nitrogen compound of which is a solid, and for which the metal has only a normal affinity. 4. A surface metal of a metal compound, the result of chemical reaction on the surface metal.

In another specification it is stated that instead of covering the core with an oxide, metals of the ruthenium-osmium class may be used. For the first coating a mixture of osmiate of potash and chloride of iridium is also referred to. Instead of the core being of carbon, it may be of a metal or other material which may be subsequently eliminated. Before immersing the core in the electrolyte, it is prepared for the deposit of osmium-iridium by a primary coating of zinc. On the osmium-iridium there may then be coated a metal of the rare-metal class.

The specifications, which were evidently in the language of the inventor, are in places quite polemical, and the matter is so discursive and the treatment so disconnected that it is very difficult to obtain a definite idea of the essential details of the inventions. Turning to the claims, those for the first patent in order of issue relate to the details of the process of plating or metallizing carbon filaments. The claims of the second patent are similar except that the term "conductive filament core" is used instead of carbon filament, though in one claim the term has the qualification "preferably carbon core"; several concentric layers are mentioned, the one on the surface containing titanium. The claims of the third patent relate to a core of carbon surrounded by an electrolytic coating of metals, the several materials of which the complete filament is composed being so proportioned that after it has been subjected to heat it will consist partly of carbon, partly of the product of the reaction between carbon and the metal, and partly of the metal. Another claim states that the filament consists finally of a central core of carbon, a concentric layer of a mixture of carbon and metal, an adjoining layer of metal of the ruthenium-osmium group, and a layer of rare metal oxidized on the surface.

CURRENT NEWS AND NOTES.

NEW YORK ELECTRICAL SOCIETY.—The next meeting of the New York Society will be held on board of the Cunard steamship *Lusitania* at 8 p. m. Wednesday, Feb. 5.

A MONSTER TELEPHONE.—It is stated, but we had not had the curiosity to test the assertion, that if all the Bell telephones made each year were blended into a single instrument, it would be nearly 300 miles high and weigh 4000 tons. This seems like tall talk.

OHIO ELECTRIC LIGHT ASSOCIATION.—At an executive meeting of the Ohio Electric Light Association, held at Columbus, Ohio, last week, it was decided to hold the next convention Aug. 25, 26 and 27, 1908. The place has not been definitely decided upon.

UNDERGROUND CONDUIT CONSTRUCTION.—Mr. Bernard C. Groh, formerly conduit engineer with the American Telephone & Telegraph Company and now engineer of the American Conduit Company, addressed the Chicago branch of the A. I. E. E., Jan. 21, on "Electrical Subway Construction."

TELEGRAPH RATES.—Senator La Follette, of Wisconsin, has introduced at Washington a bill to regulate the interstate transmission of telegrams. He believes that the interstate business of telegraph companies should be under the Interstate Commerce Commission, as interstate railroad rates are regulated. The bill also prohibits government employees from accepting telegraph franks.

ILLUMINATING ENGINEERING.—The next meeting of the New York Section of the Illuminating Engineering Society will be held at the United Engineering Societies' Building, 33 West Thirty-ninth Street, Thursday evening, Feb. 13, at 8:15 o'clock. Mr. George Leland Hunter will present a paper on "Light and Color in Decoration." An invitation is extended to readers of this journal to be present.

MAKING DIAMONDS.—Great interest continues to attend the charges against Lemoine for obtaining money fraudulently under pretence of making diamonds electrically. A sensation has been caused by the testimony of diamond dealers in Paris that Lemoine bought stones from them through his wife at the time of his alleged successful experiments, and that the stones are identical with those which he claims to have been the product of his furnace.

ALUMINUM STORAGE BATTERY.—Dr. Otto Reinhold, of Newark, N. J., claims to have produced a storage battery the weight of which is only 20 per cent of that of a lead battery for the same amount of electrical energy stored. Constructive details have as yet not been disclosed, but the inventor states that in the plates use is made of aluminum and iron oxide immersed in a solution that is harmless to aluminum. It is claimed that, in addition to being extremely light in weight, the battery possesses a high efficiency, can be charged at a high rate and is inexpensive in operation.

COOLING OF TRANSFORMERS ON RAILWAY CARS.—In a patent issued Jan. 21, Mr. Walter S. Moody proposes to increase the air circulation through a transformer on a railway car, by connecting the intake pipe of the air-compressor, which fills the reservoir with air for the operation of the car brakes, to take air from the interior of the transformer. By this method the air circulation through the transformer is increased in an advantageous manner, because the brakes are used most frequently and consequently the air pumped most rapidly by the compressor when the car is running at comparatively low speed and when therefore the circulation produced by the motion of the car proper is least noticeable.

CARNEGIE INSTITUTE STUDIES.—The marine observations in the Pacific Ocean, conducted by the Carnegie Institute, of Washington, during the last year, lead the officials to believe they can save the great ocean liners from $1,000 to $2,000 on each voyage. According to the year book of the institution, just issued, measurements of magnetic declination, dip and intensity were made, and a new magnetic chart, correcting errors in former charts, has been made, and mariners, it is said, will now be able to steer much straighter courses. The Galilee, the vessel employed in the survey, according to the year book, has traversed over 50,000 miles along courses where few magnetic observations have been previously made.

COMPENSATING WINDINGS FOR SINGLE-PHASE COMMUTATOR MOTORS.—Since the m. m. f. of the current in the compensating winding of an alternating-current commutator motor should equal the m. m. f. of the current in the armature, a large number of turns will be required for the compensating winding if the current through these turns has a value no larger than the armature current. In a patent issued Jan. 21 to Mr. E. F. W. Alexanderson means are disclosed for obtaining a current equal to at least twice the armature current for use in the compensating windings. The scheme proposed consists in connecting a plurality of armatures in parallel and connecting the compensating windings in series. The object in employing a small number of turns in the compensating winding is to save the extra space required for insulation in the slots in the pole-faces when more than one conductor is placed in each.

EIFFEL TOWER WIRELESS.—A special cable dispatch from Paris of Jan. 25 says: "The Government has begun the installation of an elaborate apparatus for wireless telegraphy in the Eiffel Tower, by which it hopes to be able to communicate directly with New York. General Picquart, the Minister of War, is convinced that on account of the splendid results attained by the wireless system, by means of which messages were sent here direct from Morocco, a distance of about 2000 kilometers, the establishment of an instrument in Eiffel Tower would prove most useful as a part of the national defense in time of war. Lieutenant-Colonel Chales, Director of the Military Telegraphs, said to-night that he expected important results from the contemplated arrangement. He pointed out that with the great height of the Eiffel Tower a message should theoretically go around the world, returning to the tower." The idea is to keep in direct touch with French warships in any part of the world.

ATLANTIC WIRELESS SYSTEM.—A special cable dispatch from London, of Jan. 21, says: "Before his departure for Ireland to-night Mr. William Marconi said that the transatlantic wireless system will be opened to the public on Feb. 1 or 2, and that in the beginning the service will be between London and Montreal only via Clifden, Ireland, and Poldhu, Cornwall, on the eastern shore of the Atlantic, and Glace Bay, on the western shore. Montreal was chosen as the beginning point for the transmission of business and private messages because Canada has subsidized the wireless system to the extent of $80,000. In explaining the effort of the American telegraph companies to stifle the wireless company, through fear of its competition, Mr. Marconi said: 'The telegraph companies placed a grave obstacle in the way of our success by refusing to accept at press rates messages filed in New York for transatlantic transmission via Glace Bay, thus adding from 3 to 4 cents a word to the cost of an east-bound message, while the regular press rates from New York to Glace Bay were only 1 cent a word. This difficulty was solved by the New York editors with reference to west-bound messages by appointing me their Nova Scotia correspondent.' The rate on private messages between London and Montreal will be only 12 cents a word. It is understood that no attempt will be made, at least for the present, to lay private wires to the wireless terminals."

MINNESOTA CENTRAL STATION ASSOCIATION.—The first meeting of the Minnesota Central Station Men's Association will be held at Hotel Nicollet, Minneapolis, Feb. 28 and 29. Mr. A. H. Lane, superintendent of the Glencoe Electric Light Company is temporary chairman.

BOSTON BRANCH ILLUMINATING ENGINEERING SOCIETY.—At an election, held Jan. 14, the following officers of the Boston Branch of the Illuminating Engineering Society were elected: President, Mr. J. S. Codman; secretary, Mr. Ware; managers, Messrs. W. H. Blood, Jr., and T. H. Piser.

CIVIL SERVICE.—The New York State Civil Service Commission will hold examinations on Feb. 15 for an assistant electrical engineer, salary $600 to $900 per annum, and maintenance. The last day for filing applications is Feb. 8. Full data and forms can be obtained from Mr. Charles S. Fowler, chief examiner, Albany, N. Y.

PAINLESS ELECTROCUTION.—A special dispatch from Paris states that Dr. Leduc, a professor at the School of Medicine, in Nantes, who has been experimenting in the slaughter houses of that city on the electrocution of animals by intermittent low tension currents, is about to repeat his experiments in the Parisian Abattoirs at Vaugirard. He claims that the system is painless, the central functions of perception being first destroyed and then those of respiration and circulation, and that there is consequently neither suffering nor reaction from the animals thus killed.

TELEGRAPHY IN CUBA.—Mr. A. Campbell Turner, chargé d'affaires of the American legation at Havana, forwards copies of three decrees of the provisional governor of Cuba establishing state telegraph offices, to be connected with the postoffices in the following places in Pinar del Rio province: Orozco, Quiebra Hacha and Cabanas. In these offices the postmaster is to be required to pass an examination as telegraphist and is to fill both posts. It is proposed in the future, in all the smaller towns in the interior of the island where the work of the postoffice will so permit, to combine the offices of postmaster and telegraphist and to make applicants for these positions pass an examination in telegraphy before receiving their appointment.

A DEAF OPERATOR.—If the Kennebec, Me., *Journal* is believed, Peter A. Foley, the "lightning taker" of Portland, is the most wonderful telegraph operator in the world. He is totally deaf, an affliction which ordinarily would be supposed to make ordinary telegraphy an utter impossibility to him, but since he became deaf eight years ago, Foley has developed what may be called a sixth sense and by touch and sight he can detect the finest movements of the instrument and interpret them. His nervous system is a part and parcel of telegraphy and by means of the sense of touch in his finger tips he takes messages. He can read a message by watching the sounder, it is alleged. With his left forefinger placed lightly on the sounder, he can by his sense of touch take a message as accurately as any man in the office.

FRUIT CROP PROTECTION.—The United States Weather Bureau has just put into operation a plan by which it is thought fruit growers throughout the orange belt of San Bernardino, Riverside and Los Angeles counties, of California, will be given ample protection from damage to crops by frost. In this district sudden changes in temperature are not unusual during winter months, and it has been found that the printed charts issued by the Weather Bureau do not insure sufficient protection, especially in the remote portions of the great orange belt. Arrangements have been completed by which it is possible to send warnings by telephone at any hour of the day or night. Sub-stations have been established, to which warnings will be sent, and from these sub-stations the warnings will be sent to growers, nearly all of whom have telephones and can be reached quickly. Whenever a sudden drop in temperature is expected it will be known in ample time for the growers to protect their crops by smudging or in other ways. A clerk will be on duty at the Los Angeles office of the Weather Bureau at all hours to send out such warnings.

..COMPETITION IN BRAZIL.—U. S. Deputy Consul-General J. J. Slechta, of Rio de Janiero, states that the latest phase of the competition between the Brazilian company and the Canadian-American interests supplying electricity in all of the larger Brazilian cities has resulted in the decision of the former company to construct a rival power plant in the city of Sao Paulo, with the hope of in some way finding a loophole in the monopoly of the tramway system held by the foreign company. In the meantime they propose to construct an electric line between Sao Paulo and Santos, thus competing with the existing steam railway and menacing the success of the proposed extension of the Sorocabana Railway, which is controlled by the same group of capitalists interested in the tramway system. The Brazilian company is also making a hard fight to invade the territory of the foreign rival by securing such legal decision as to its respective rights in the matter as will permit the former to compete with the foreign concern in supplying electrical energy to the government consumers in the Federal capital. Both companies have large water-power plants, adequate in capacity to supply all the electricity needed by the city at the present time.

LONDON SUBWAYS.—Mr. W. B. Parsons addressed the Columbia University Engineering Society last week on "Some Engineering Things That Are Not Engineering." He said: "When I was appointed chief engineer of the Rapid Transit Commission in 1894 I was sent abroad to investigate the rapid transit systems of the European cities. At that time the London tube had just been completed, and seemed to be a success. The press of this city and a large number of influential men had declared that the solution of New York's difficulty lay in a similar tube. When I returned I had seen the only tube in existence and two others that were in course of construction. From my observations I had grave doubts that the tube would be a success in London, but I had no doubt that it would not be a success in New York. Our public would never put up with its inconveniences. But what was I to do? On the one hand was the backing of the press and of many influential men. I had nothing but my own conviction that I was right. I had no reputation; what I was to have depended on my decision. I tell you I walked the floor, but I finally determined to stick by my opinion, and recommended a shallow subway. Since then I have had the honor of writing a report for the London Commission."

MOTORS FOR BIRMINGHAM.—U. S. Consul Albert Halstead, of Birmingham, writes as follows in regard to the conduct of the electric light and power plant owned by that British industrial city: "The electrical supply committee of the Birmingham City Council has been authorized to expend £20,000 ($97,330) for the purchase of motors. The idea is to increase the use of electricity as a motive power among small manufacturers by permitting them to hire motors from the city for power purposes. This, I believe, is a new departure in municipal business activity. At the same time there has been a reduction of the scale of charges for electricity for power purposes. Birmingham has expended several million dollars in erecting its modern electric power houses. It furnishes electricity not only for lighting and power purposes, but for the electric street cars, which the city also owns and operates. An additional plant has to be provided at an estimated cost of £231,285 ($1,125,548). There is friendly rivalry between the electric supply committee and the gas committee of the Birmingham City Council for business, each committee endeavoring to promote the use of its lighting and power facilities. The rivalry is keen, and it would seem as if it should be of advantage to both committees by leading to increase in the use of their supplies."

High-Tension Energy Transmission in Peru.

IT might seem that the western coast of Peru, with an entire absence of rain and lightning, offers to the engineer an inviting field for high-tension work. On the contrary, however, the heavy, damp fogs that drift up from the sea during the winter season penetrate to every part of the insulator and pin. During the balance of the year the insulator is covered with dust, which with the fog forms a thick coating of muddy paste that only periodical washing by hand can remove. A curious fact has been noticed in the regular manner

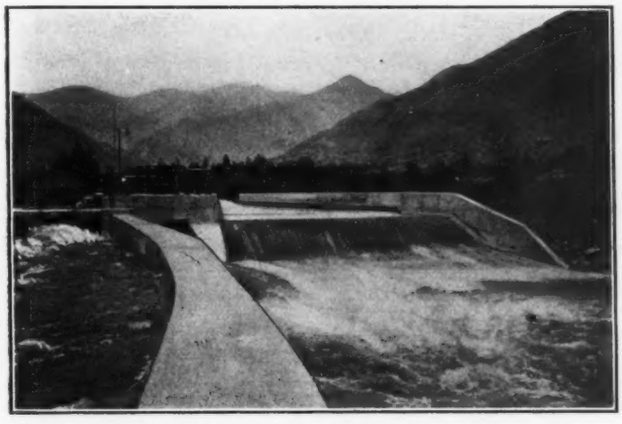


FIG. 1.—DAM AND CANAL FOR YANACOTA STATION.

that the dust particles arrange themselves at right angles to the axis of the copper conducting wire on the under surfaces of the insulators.

The first energy transmission system in South America was started in Peru in 1904. The line is 26 miles long, running from a power house, located at Chosica, to a power house at Lima. Misplaced confidence in the climatic conditions and the failure of the glass type of insulator selected were responsible for the difficulty experienced at first. After a heart-burning experience of several weeks' duration in trying to keep lines in use, the e. m. f. was reduced from 35,000 volts to 23,000 by a delta-star connection of the transformers. This voltage was maintained at the lower value until new insulators arrived. It was found necessary to change about 8000 insulators on one pole line containing two circuits of three No. 4 wires without

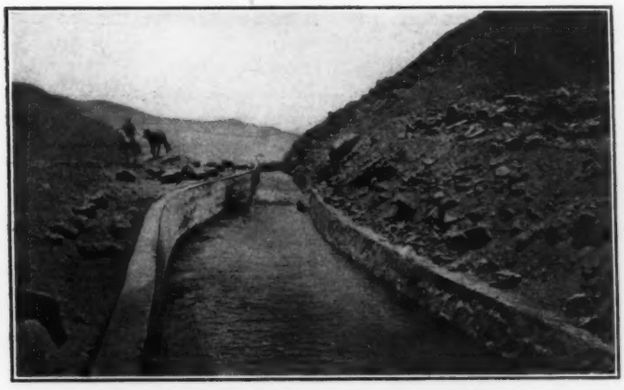


FIG. 2.—POWER CANAL FOR YANACOTA STATION.

interrupting the service. At the time of changing the insulators a second pole line was erected and each was made a single circuit.

The new insulators are of Locke make, tested to 80,000 volts, and cemented to iron pins. Wooden braces are used to support the cross arms in the place of the iron formerly erected. The iron braces offered a low resistance for the current to reach the pole, burning it at point where the arm was bolted on. The telephone wires that were located 5 ft. below had to be removed for the time being, as the transpositions, which were made every five poles, offered an easy path for the current and in many cases the poles were burned off at this point.

It was found that dry cedar poles when once afire will smolder away for hours. Thus should a top arm burn off at the point of fastening and fall away, the pole continues burning to the ground. The glass insulators would break off at the tie wire, split vertically, inside wooden thimble fastening insulator to iron pin would burn away, allowing the insulator to drop over to one side. A hissing noise made by the leaking current could be heard from two to three poles away. At night there was visible what the superstitious natives called "blue devils." With the new porcelain insulators cemented to iron pins no trouble has been experienced, although regular thorough cleaning each three months is the only guarantee of safety.

The hydraulic station at Chosica consists of three 400-kw and two 800-kw General Electric units direct-connected to Pelton water-wheels having a speed of 150 r. p. m. The wheels are of the deflecting-nozzle type controlled by Lombard governors. The effective head is 150 ft. The Rio Rimac is dammed two miles above the station and all the water during the dry season is used; excess at other times goes over the dam.

From three head-gates, located at the side of the dam, a flume or canal 6000 ft. long leads to a masonry forebay from which run the two steel pipe-lines 5 ft. in diameter to a receiver. The hydraulic grade of the canal is one-half of one per cent—rather more than is usual, but necessary here because the water carries large amounts of sand and gravel. With this grade the canal keeps itself clean and the sand does no harm to the bucket of the wheels. At the entrance to the canal, some 800 ft. from the head-gates, there is located a settling-basin for the sand and rock. A waste gate here is kept open during the wet season; this takes out a greater part of the sand and gravel.

The dam is a solid block of concrete built to withstand the heavy increase in size of the stream during flood. Ordinarily the flow is 10 to 12 cubic meters per second, but at times it reaches 200 cubic meters per second. Some 1500 ft. away, the Santa Eulalia River has been dammed and connected by a canal that empties into the Rio Rimac above its dam, thus utilizing both streams at low water. At such times both of the river beds are dry below the dam.

The Chosica station is a solid stone building, 40 ft. x 190 ft., with a separate transformer room, 16 ft. by 50 ft., in which

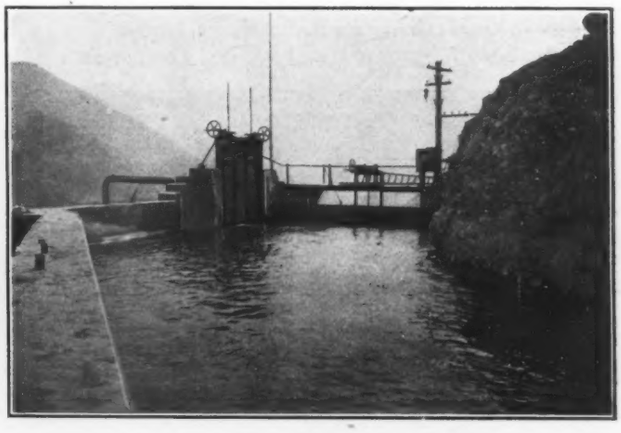


FIG. 3.—FOREBAY FOR YANACOTA STATION.

are located the high-tension switches, transformers and lightning arresters. It is so arranged that all of the power can be carried on either of the transmission lines or on the two in parallel.

At the station the e. m. f. is raised to 33,000 volts by two banks of transformers of oil-immersed and water-cooled type. At the Lima end the e. m. f. is reduced to 2300 volts, at which value energy is distributed for public and private lamps and

motors. It is again raised to 10,000 volts for operating two suburban railway lines 8 and 10 miles from Lima. The first, which runs between Lima and Callao, carried 3,000,000 passengers last year. The latter serves the suburban towns of Miraflores, Barranco and Chorrillos.

The Lima station contains a combined steam and hydraulic equipment consisting of two 27-in. McCormack wheels direct-connected to 400-kw generators. The head is 85 ft., and a 5-ft. steel pipe line 2000 ft. long carries the water to the wheels from the reservoir. A 5-ft. stand-pipe 70 ft. high and the same

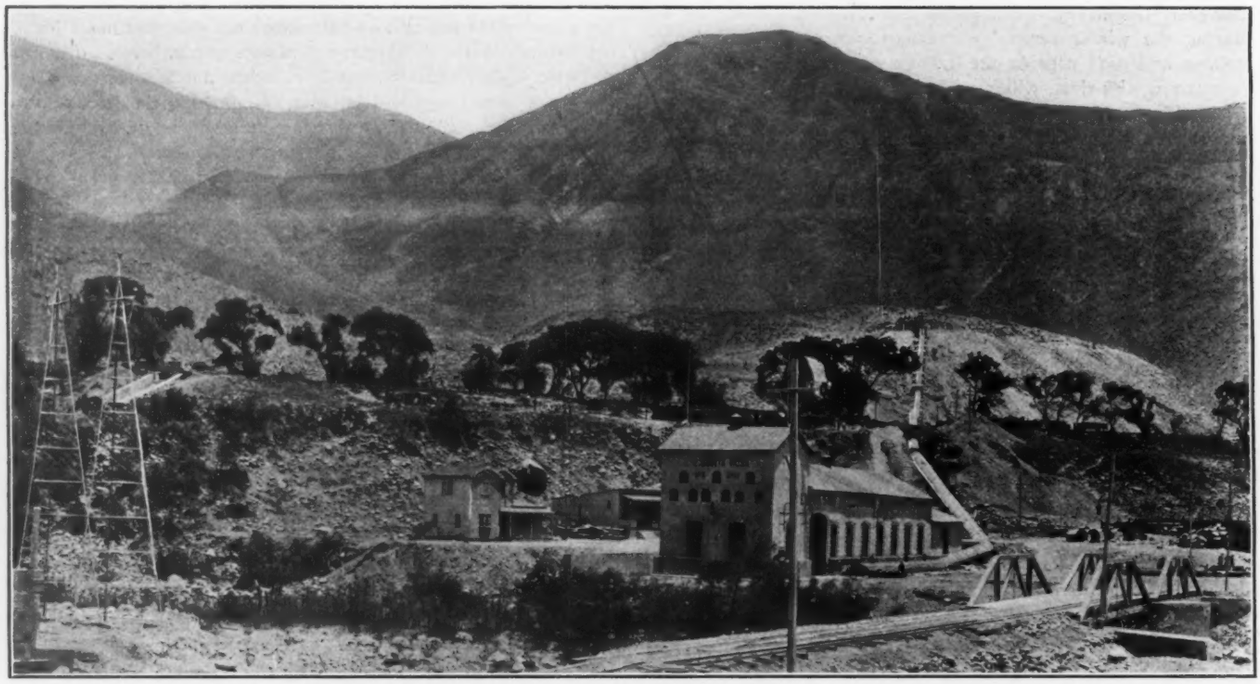


FIG. 4.—GENERAL VIEW OF YANACOTA STATION, SHOWING PIPE LINE AND STEEL TOWERS.

A third transmission line, 26 miles long, is being built between Chosica and Lima, to consist of three No. 1 copper wires, carried on 50-ft. triangular steel towers, spaced 12 to a mile. The legs of these towers are imbedded in concrete, made of a mixture of 1—3—5, and 6 ft. deep. A very careful record of the cost of the steel towers, as compared with white cedar poles, has been kept in this work. While the first cost is about 15 per cent higher, the result is decidedly in favor of the towers. A comparison of the cost of the two shows that while a cedar pole costs $10, a steel tower 50 ft. high would cost $35. The steel towers require three barrels of cement for forming a concrete basis, but it has been found that a gang of six men can erect six of these towers in a day, costing for labor 75 cents a day, or 50 cents for each tower. Each steel tower is packed in its own case separately and is much easier to transport. No cross-arms or pins are required, as these are included with each tower. While an insulator of slightly higher resisting strength is required for the steel poles, the additional cost is not noticed, owing to the lessened number required.

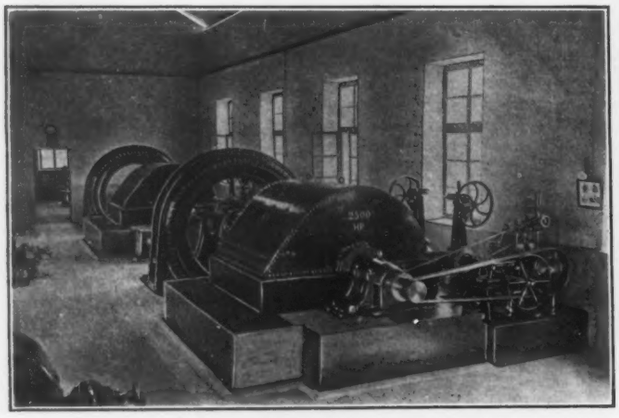


FIG. 5.—INTERIOR OF YANACOTA STATION.

diameter acts as a relief valve to the pipe line. Lombard governors are used.

The steam section of the Lima station comprises seven 500-hp B. & W. boilers. McIntosh & Seymour and Westinghouse vertical compound engines are used. A 1000-hp Curtis steam

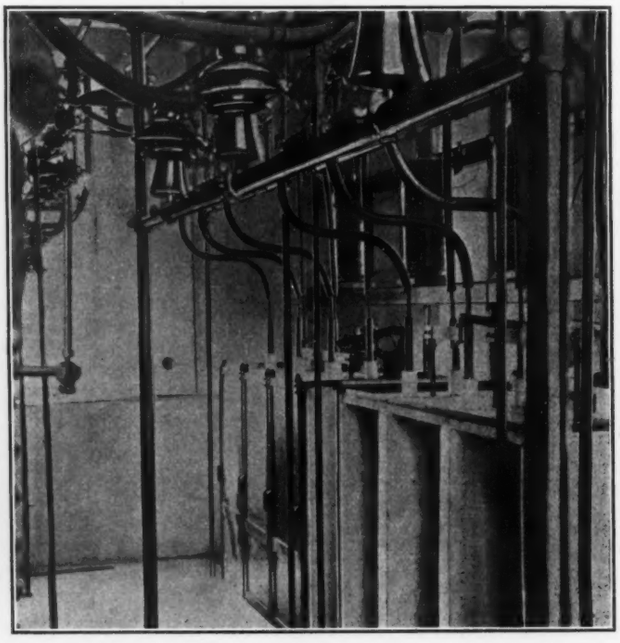


FIG. 6.—HIGH-TENSION SWITCHES IN YANACOTA STATION.

turbine has just been installed. The fuel used is crude oil from the Peruvian oil fields. This costs at the furnace $12 in gold per ton.

The heat from the oil is very intense, so that a special construction of furnace is required in order to prevent the rapid

destruction of the boiler tubes. An extension front to the furnace is used, 5 ft. long, containing from three to six burners of the steam and oil-blast type. Just in front of the bridge wall several arches are built of specially shaped fire brick in sections, the number depending upon the burners that the boiler uses. The distance from the mouth of burner to back arch is 12 ft. The back sections, which are 18 ins. deep, just come up to the bottom of the boiler flues. They receive the direct blast of the burning oil, which then spreads to the tubes. Before the present arrangement was adopted the tubes in the boilers were rapidly destroyed, owing to the intense heat from the oil flames.

The generators at the Lima station are operated in parallel with those at the Chosica station, 26 miles away. A third hydraulic station, at Yanacota, the cornerstone of which was laid by Secretary Root during his recent South American visit, has just been completed, and is now supplying energy in parallel with the other two stations. When not acting as generators, two or more of the Lima generators are operated as synchronous motors for the purpose of raising the power factor of the system.

FIG. 7.—OVERFLOW OF CANAL AT FOREBAY FOR CHOSICA STATION.

A concrete dam 20 ft. high has been built below the Chosica station, and the same water is used over again. The canal is three miles long, 6 ft. in height by 18 ft. wide and has a hydraulic grade of 3 ft. to the mile. For about one-third of the distance the canal is excavated out of the rock of the mountain side. Some 20,000 barrels of cement were used in this canal inasmuch as a large part of the canal had to be lined.

From the forebay a steel pipe line 6 ft. in diameter and 1300 ft. long conducts the water to the station. An effective head of 250 ft. is secured. The station contains three General Electric, 1250-kw units, direct-connected to 2500-kw Pelton waterwheels. Lombard governors are used. The building is constructed of reinforced concrete 35 ft. x 150 ft., with steel roof, and is perfectly fireproof. Two banks of transformers and all high-tension apparatus are located in a separate room. The transformers are of the oil-immersed and water-cooled type. This equipment is worked in parallel with the other stations. the demand for electrical energy throughout the territory served increases.

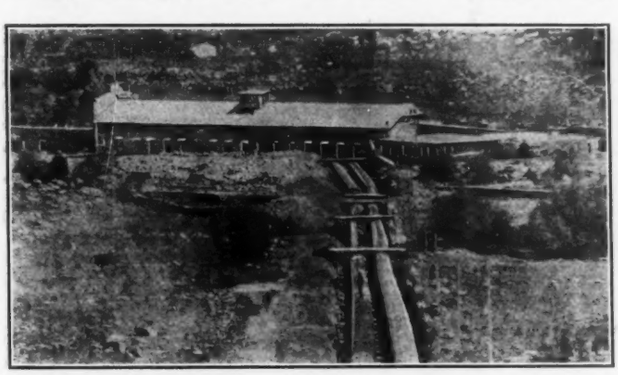


FIG. 8.—PIPE LINE TO CHOSICA STATION.

The Lima distributing station supplies energy during the day to innumerable small factories, some large cotton and woolen mills, flouring mills, and three electric roads. The tramways of Lima have just been equipped for electric operation and are running 60 Stevenson open eight-bench cars, having two 25-hp motors. The cars are fitted with air brakes. On the two suburban roads the cars use two 50-hp motors, partly multiple control. Each road has from 15 to 20 cars of the Brill and John Stevenson manufacture, seating 40 passengers. Use is made of air brakes and automatic storage batteries that switch on the car lamps in the event of the trolley leaving the wire at night. Each of the sub-stations of the three electric roads is equipped with from three to five 300-kw General Electric rotary converters. The two suburban roads have double tracks and give a five to eight minute service. The fare in the city is 5 cents silver or 2.5 cents gold.

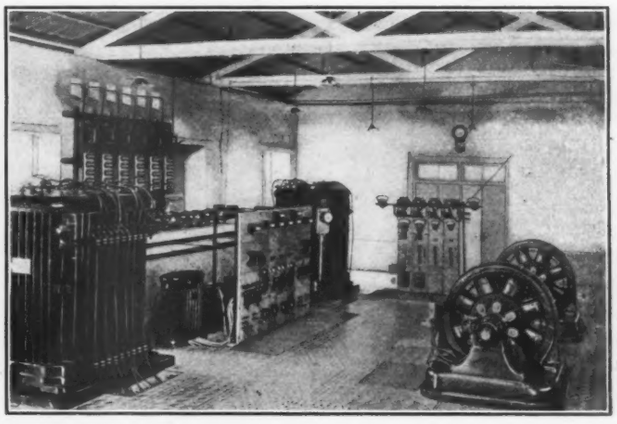


FIG. 9.—SYNCHRONOUS CONVERTER STATION FOR LIMA AND CALLAO ELECTRIC RAILWAY.

The rates for energy for lamps are 15 cents in gold per kw-hour; for motors the rates are $4 per month per horse-power or 2 cents per kw-hour. This low rate encourages manufacturing and keeps the peak down. Fuel is quite expensive in this territory, coal selling at $12 per ton and crude oil at the same price.

There is very little coal produced in Peru, and such as there is contains a large percentage of ash. The Cerro de Pasco Mining & Smelting Company is mining coal which makes good coke, after being washed. Electric energy, being much cheaper, has gradually superseded steam, alcohol, kerosene and gasoline, all of which were hitherto quite extensively used.

Peru has shown marked advancement during the past five years and the investment of some $15,000,000 by New York capitalists in copper mines and smelters during the past three years is only a single evidence of confidence. During the past year, through the efforts of Dr. Mariano I. Prado-Ugarteche, manager of the Empresa Electrica de Santa Rosa and the Lima & Callao Electric Road, and Messrs. Joaquin and Emilio Godoy, managers of the Ferro-Carril Electrico Lima-Chorrilos and the Ferro-Carril Urbano de Lima, a consolidation of all the electric lighting, gas, power and railway interests was effected. The capital stock is $7,500,000 in gold, all of which is Peruvian capital except $1,000,000 in bonds sold in New York.

All of the electrical and hydraulical work in connection with this first energy transmission system in South America for the past seven years has been planned and executed by Mr. A. L. Kenyon, chief engineer, to whom we are indebted for the information contained in this article.

Artistic Illumination—Murray's Restaurant, New York City.

By H. Thurston Owens.

THE New York public, which, of course, includes its visitors, is fickle regarding its choice of restaurants as it is in other things; and its latest hobby is "Murray's." Many go there out of curiosity, some to see the other people, others for the music, and a few to enjoy the excellent cuisine. The building is on the south side of Forty-seond Street, between Seventh and Eighth Avenues, an admirable location, for it is surrounded by theaters, the nearest ones being the Liberty, Hackett, Lyric, Belasco's and the New Amsterdam.

The ouside appearance, with its illuminated lettered sign and two blinding, flaming arcs over the doorway, is not in keeping with its reputation for attractiveness. The entrance doorway, shown at the left of Fig. 1, is unpretentious, but upon entering, the observant will be struck by the handsome bronze figure of a flower girl in a niche at the side of the lobby, the flowers

FIG. 1.—ENTRANCE TO MURRAY'S RESTAURANT.

of branch which she holds being miniature electric bulbs. The foyer beyond appears to be a room of some size, as shown in Fig. 3, with a beautiful mosaic glass table with suspended ball above, in the center of the room. Both are illuminated by means of lamps behind the glass, the effect of this being decidedly novel and effective.

A closer investigation shows that the half of the room at the left of the photograph is mirrored, and that there is only half of a table and a hemisphere above. The deception is, however, so skilful that it is probably detected by few visitors passing through. Upon leaving the foyer you are immediately ushered into the main dining room, after being deftly relieved of your coat, and you begin to wonder whether you are in a restaurant or a garden of some "Nouveaux riche" American,

FIG. 2.—FOUNTAIN IN MAIN DINING ROOM.

who is entertaining an informal gathering. Here is a fairyland of lamps, a fountain splashes over crystals of blue, stars blink in the sky, and the clouds roll by, all to the accompaniment of sweet music and the hum of conversation.

People appear to be moving about in the adjacent rooms and you are the only one not quite at ease, for no maze, whether it be one of crystal, which may be seen in gay Paris, or one of flowers and shrubs as in Golden California, ever pleased you quite as much as this one does. You have hardly regained your composure when you are startled by a soft red glow coming through the table cover of spotless linen and naturally you can obtain no definite conception of the size and proportions of this dining place. It would be hard to realize that, in fact, there are no adjacent rooms and the total dimensions are only 75 x 60 x 24 ft. A portion of this room is shown in Fig. 5.

FIG. 3.—FOYER; MURRAY'S RESTAURANT.

The design is in Roman style, and the effect is that of a garden, with trees, plants, and myriad colored lamps. The apparent great size is produced by the south and west walls being mirrored to the ceiling and the north and east furnished with balconies and decorations. The columns, caryatides, statues, urns, vases, etc., are of concrete of dull gray color, the ceiling is deep blue, the mural paintings and the fountain are illuminated with blue light, bunches of grapes made of glass and enclosing lamp bulbs, hang from the vines along edge of balcony; there are chandeliers, pendant balls, and table lamps with mosaic glass of many shades and hues, and the general effect is gay and brilliant but not at all hard on the eyes. Here

FIG. 4.—PART OF THE BALCONY, LOOKING WEST.

is an example of concealed lighting of the highest order and an arrangement of mirrors which could hardly be surpassed.

Fig. 6 shows a portion of the main dining room, under the balcony, which illustrates the method used to produce the effect of distance in this brilliantly lighted room. All light from

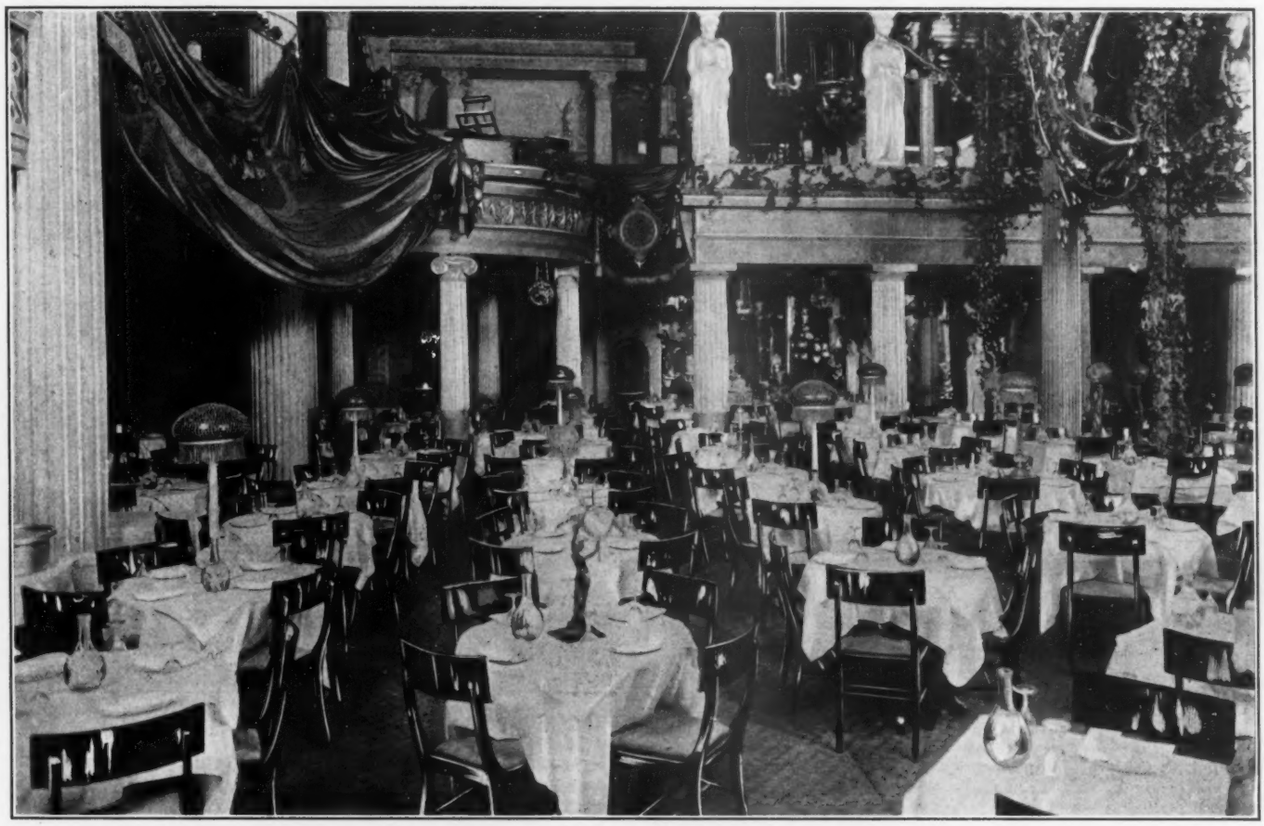


FIG. 5.—GENERAL VIEW OF MAIN DINING ROOM AND BALCONY.

FIG. 6.—PORTION OF THE MAIN DINING ROOM, UNDER THE BALCONY.

ARTISTIC ILLUMINATION IN MURRAY'S RESTAURANT.

ceiling fixtures is either thrown up against the ceiling or thoroughly diffused, and the reverse effect obtained with the table portables. Were there direct reflection from the mirrors from unconcealed lamps the effect would be spoiled.

Fig. 2 shows the fountain, all made of mosaic glass, the predominating color being blue. There are clusters of clear incandescent lamps under the glass and inside of the ball supported by the figures at the top. Back of the surrounding wall, which is also of mosaic glass, are blue incandescent lamps.

FIG. 7.—PORTION OF THE BALCONY.

In addition to these lamps, there are three 100-cp spot lamps with blue gelatine over lens, which add to the blue color effect of the fountain. These are not of sufficient power to give a satisfactory result and one arc lamp is to be substituted. The stars in the ceilings are 4-cp clear lamps in "skeedoodle" sockets placed above frosted glass. The cloud effect is produced by

FIG. 8.—CORNER OF MAIN DINING ROOM.

means of an arc with moving photographic plates. Some of the tables have tops of plate glass with two 16-cp red lamps underneath.

Since the building was completed, a few beaded ball fixtures of clear glass have been added, but they kill the color effect and spoil the distance effect in mirrors. These, however, are to be removed.

The balcony is a mezzanine floor of irregular shape, extending over the main dining room, as previously mentioned, and is furnished in three types of architecture: Roman, Greek and

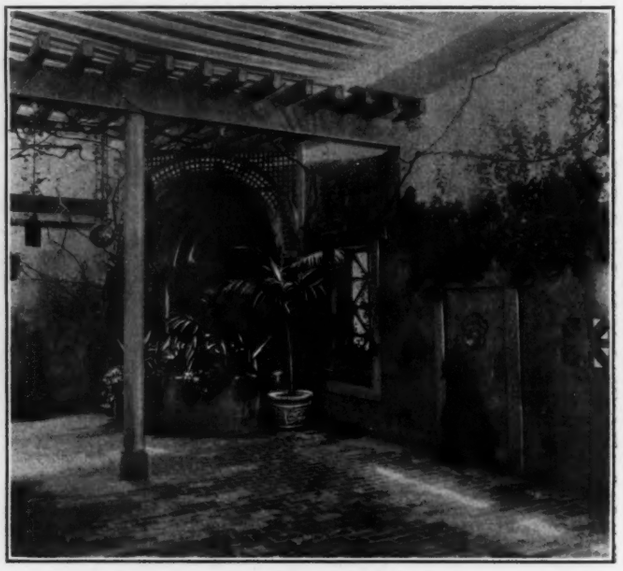


FIG. 9.—FOUNTAIN ON ROOF GARDEN.

Egyptian. The decorations are all very ornate as in the dining room below, but there are no mirrors.

There are seven distinct types of lighting fixtures upon this floor and two schemes of indirect lighting as well. There are chandeliers with hemispheres of blue-green mosaic glass, suspended spheres of green mosaic glass, chandeliers with three upright frosted globes tinted green, standards in the form of Egyptian tripods, with blue-green mosaic glass shades, round frosted ball lamps forming part of decorative figures on the ceiling, table lamps with red silk shades, and others with shades of yellow silk; and all of the mural paintings are illuminated by means of blue lamps in tin trough reflectors, and clear lamps in reflectors are placed behind the windows of mosaic glass.

Figs. 4 and 7 show two portions of the balcony and many of the types of lamps in use. There are a number of mural

FIG. 10.—PRIVATE SUITE; MURRAY'S RESTAURANT.

paintings similar to the one shown and all are illuminated by means of blue lamps. Still another feature of the lighting installation is shown in Fig. 6 for, although the chandeliers are quite near the mural paintings, there are no cross lights, as all downward light is well diffused. Figs. 8, 12, 13 and 14 show

several of the lighting fixtures in detail, and the originality and equipment is thoroughly in keeping with the other furnishings.

FIG. 11.—BALCONY, LOOKING EAST, SHOWING VIEW OF ATHENS.

FIG. 12.—CORNER OF BALCONY.

The remaining public rooms for dining purposes are located upon the third floor, and are known as the Peacock Room, Banquet Hall and Private Dining Room; the first two are adjoining and are decorated in Egyptian style, the last being in Gothic.

The lighting effect is very soft and restful, in great contrast with the dining room and its balcony. The same scheme of indirect lighting is used in these rooms, but as the walls and ceiling are dark in color the amount of reflected light is small.

The private dining room is in Gothic style, its size being 22 x 22 x 12 ft., with walls in tapestries, and paneled ceiling; the lighting fixtures are ceiling clusters of 8-cp frosted lamps, consisting of four 4-cluster and one 12-cluster fixture.

FIG. 13.—CHANDELIER IN EGYPTIAN BALCONY.

FIG. 14.—EGYPTIAN STANDARD.

The Peacock Room is 68 x 25 ft., and the Banquet hall 28 x 26 ft. Both are 12 feet high, and the color scheme is peacock blue and gold. Only table d'hôte dinners are served here and

The roof garden is on the same floor as the Peacock Room, being 75 x 34 ft., and is in Pompeian style, with walls in concrete of natural dull gray color. The two fountains are of especial

merit, having been designed by the late Stanford White. The illumination is furnished by means of pendant fixtures as shown in Fig. 9, and in addition a number of spot lights are thrown upon the plaster models of famous statuary to be found here.

The bar is on the Forty-second Street side and is in Egyptian style with wood work of mahogany, the general color effect being red. It is equipped with inverted hemispheres similar to those used throughout the building, and in addition there are ceiling clusters of bare lamps. These latter provide the "glare" without which no American bar is considered to be complete.

The remainder of the building consists of bachelor suites, one of which is shown in Fig. 10. The service portions of the building are lighted by means of clear 16-cp bare lamps on flexible cords and have no reflectors.

The energy is furnished from the mains of the Edison Company, the total installation being the equivalent of 1600 16-cp lamps. There is a panel board on each floor and individual switches on the portables and the large chandeliers. All lamps which are unconcealed are frosted, being nearly all of 16-cp with some 8-cp; all concealed lamps are clear 16-cp. The wiring cost over $12,000.

That the lighting features of the place have "caught the town" is evident by the fact that the dining room was reproduced as the final scene of one of the popular burlesques on Broadway, and the lighting effects were as much praised as the cleverness of the copy. The lighting of this building is far from the realm of foot candles, efficiency and other commercial terms, for it is probably the most elaborately lighted restaurant in the world. It is an installation which is well worthy of the attention of illuminating engineers, for it is not merely a novelty—it is a decided step forward in the art of illumination.

A Study of the Illumination of Interiors.

In 1901 a University of Wisconsin thesis was submitted at graduation by Messrs. E. F. Legg and H. I. Townsend entitled "A Study of the Illumination of Interiors," and dealing chiefly with measurements of illumination made in libraries and public buildings. Had this thesis been given five years later when more attention was being paid to illumination it would undoubtedly have attracted much wider attention, although the tests showing the detrimental effects of dirt on lamps and reflectors have been quite extensively quoted as being, for a long time, the only data obtainable taken from commercial conditions. Besides these tests other interesting facts were brought out by the authors as to the relative amount of natural (daylight) and artificial illumination commonly existing in the buildings studied.

The tests were made with a Weber portable photometer, with a benzine lamp for a standard. Although the results may be open to objection due to the unsatisfactory nature of such a flame standard for field work, there is nevertheless much to be learned from the figures, even considering them as rough approximations.

The following tests show the effect of dust on lamps and reflectors in the Chicago Public Library reading room. The tests were made on the reading tables, first with the lamps and reflectors in the condition in which they were found at the time the test was made, and, second, after cleaning the lamps and reflectors. The reflectors employed were the common green-plated conical opal desk shades so frequently found on the reading tables of public libraries.

Candle-feet, before.	Candle-feet, after.	Difference.	Per cent increase
2	3.15	1.15	75
1.75	1.90	.15	8.6
1.60	2.05	.45	28.2
1.50	1.73	.23	15.3
1.55	1.80	.25	16.2
1.60	2.10	.50	31.3
1.40	1.70	.30	21.4
Average,			28.0

The general artificial illumination was measured in a number of the buildings studied. The following figures are the average of a number of readings taken in the places specified.

In gallery reference room, Milwaukee public library	.8
General delivery of above	1.1
In art room, Chicago public library	.74
In small reference room, Chicago public library	.8

The following is a comparison of the daylight and artificial illumination in a number of locations in the three following libraries: Newberry Library, Chicago; John Crerar Library, Chicago; State Historical Library, Madison, Wis.

	Candle-feet. Daylight.	Artificial.
At small tables in stacks	5.0	3.0
Among stacks	2.2	0.6
Corridors	1.5	.4
Stairways and rotundas	11.2	.8

The illumination on reading-room tables was measured by night and by day in a number of libraries with the following results, which are the averages in each case of a number of readings:

	Candle-feet. Night.	Day.
State Historical Library, Madison, 1:30 p. m., May 18; clear	3.50	5.5
Milwaukee Public Library, cloudy day, February	1.60	11.8
Chicago Public Library, clear; 3:30 p. m.	1.67	21.0
Newberry Library, noon, Feb. 11; cloudy, with sun at times	1.65	35.0
John Crerar Library	1.48	5.3
Average of library tables	1.98	15.7

The following measurements were taken near walls in two art galleries by night and by day:

	Night.	Day.
Art Institute, Chicago	1.0	8.6
Layton Art Gallery, Milwaukee	...	10.6

In the State Historical Library reading room, at Madison, Wis., the foot-candles on the reading tables by night were 7 as a maximum and 1.6 as a minimum. The tables are lighted with the table lamps under the usual green plated conical opal desk shades, supplemented with general lighting from high side brackets. Tests of the daylight illumination on the same table showed 9.5 foot-candles maximum and 1.6 foot-candles minimum. The daylight tests were made at 1:30 p. m., May 18, 1901. The day was clear. The curtains were partly drawn.

Tests in the Milwaukee Public Library reference room showed a maximum artificial illumination of 2.52 foot-candles and a minimum of 1.3. The daylight illumination was 4.3 maximum and .7 minimum. The daylight tests were taken on a cloudy day in February.

In the Chicago Public Library reading room, which extends across the north end of the building, daylight tests made at 4 p. m., with the west curtains half drawn, showed a maximum of 31 foot-candles and a minimum of 2.6 foot-candles Tests under artificial illumination showed a maximum of 3.6 foot-candles and a minimum of .7 foot-candle.

In the Newberry Library, Chicago, night and day tests were made in the general reading room, which has windows on the south facing on a park. Tests of the day illumination were made on a day in which there were rapidly moving clouds, with the sun breaking through at times. The maximum daylight illumination was 104 foot-candles and the minimum 3.4. The great variation was, of course, due to the intermittent clouds. The night illumination was a maximum of 2.5 and a minimum of 1.22 foot-candles.

A number of readings were taken in the Studebaker Theatre, Chicago. The average of these readings was 1.44 foot-candles; the maximum being 2.3 and the minimum .6. Very few readings were below 1 foot-candle.

Readings in the Illinois Theatre, Chicago, showed an average of .6 foot-candle, the maximum being 1.2 and the minimum .2. Many readings were below .7 foot-candle.

Some of the authors' conclusions and remarks are as follows:

Readers in a library seem to prefer a room with dark or dull finish. The Newberry and Crerar libraries, in Chicago, were the most effectually illuminated of those studied. These are finished in dark colors and have a low general illumination—less than .3 foot-candle. The authors think that .5 foot-candle is ample for the general illumiation of a reading room, leaving the rest to be supplied by shaded table lamps. They also conclude that readers prefer the lowest illumination consistent with ease of seeing.

Electrical Engineering Education.

At the special meeting of the A. I. E. E., held in New York on Jan. 24, Dr. C. P. Steinmetz presented a paper dealing with those features of our electrical engineering education which he considers unsatisfactory.

Dr. Steinmetz stated that in general the conditions for a good electrical engineering education in the United States are far more favorable than anywhere else; for an electrical engineering industry developed to a higher degree and to a greater magnitude than in any other country offers a very large field of application to the graduate engineer, thus supplying an incentive to enter this profession. Unlike other countries, where some opposition to the college-trained man, as unpractical, still lingers, the electrical industries here prefer, and in many instances demand, a technical college training for their engineering staffs. There is a tendency now to demand this training even for administrative and commercial positions. This leads to a close co-operation between the electrical industry and the engineering college. The leaders of the industry take a close and active interest in technical educational work, while teachers of engineering consider it as their foremost duty closely to follow and keep informed of the advances of the electrical industries, sometimes even are actively engaged in industrial work; and as early as possible the students are introduced to the industry by visits to factories, inspection trips, etc., which become more and more an important part of the college education. This is as it should be, and probably constitutes the strongest feature of American engineering education.

While many, especially smaller colleges, are not financially strong, in general the means available to the American college of engineering are far superior to those abroad, and especially in erecting engineering buildings, laboratories, etc., much has been done.

The great defect of the engineering college is the insufficient remuneration of the teaching staff; the salaries paid are far below those which the same class of men command in industrial work, and as a result the college cannot compete with the industry for its men, but most of the very best men are out of reach for the colleges. The teaching forces of the colleges, therefore, consist of: 1. A few of the very best men, who are especially interested in educational work to such an extent that they are willing to sacrifice financial returns for it. These men have made the engineering college what it is; but even many of these men are ultimately forced by considerations of family, etc., to leave college work and enter industrial employment. 2. Many younger men interested in teaching, enter college work to give it a trial. Some of these remain, but many return to industrial work, when they are forced to realize the small prospect of financial return offered by the college. 3. First-class men who devote a part of their time to the college and a part to industrial work, usually consulting engineering. This arrangement is probably the best for the college, handicapped as it is by the policy of salaries which may have appeared sufficient in branches in which no industry competes, but which are suicidal in the engineering department. Still it would be far preferable if the colleges could get the benefit of the whole time and the undivided interest of these men.

It appears, therefore, that a vast improvement could be made in electrical engineering education if a large part of the sums which are now devoted to marble engineering buildings and fancy laboratory equipments could be devoted to offer such salaries as to make available to the colleges the undivided time and interest of the best men in the field. The name of the donor may just as well be perpetuated by the professorship which he endows, as by the pile of marble which he erects for the college. After all, engineering buildings and college laboratories are of very secondary importance compared with the qualifications of the teacher and his assistants.

To the subjects taught and the methods of teaching very grave objections may be made. The glaring fault of the college curriculum is that quantity and not quality seems to be the object sought: the amount of instruction crowded into a four years' course is far beyond that which even the better kind of student can possibly digest. Memorizing details largely takes the place of understanding principles, with the result that a year after graduation much of the matter which had been taught has passed out of the memory of the student, and even examinations given to the senior class on subjects taught during the freshman and sophomore years, reveal conditions which are startling and rather condemnatory to the present methods of teaching.

It stands to reason that with the limited time at his disposal, it is inadvisable for a student to waste time on anything which he forgets in a year or two; only that which it is necessary to know should be taught, and then it should be taught so that at least the better student understands it so thoroughly as never to forget it. That is to say, far better results would be obtained it half or more of the mass of details which the college now attempts to teach, were dropped; if there were taught only the most important subjects—the fundamental principles and their applications—in short, all that is vitally necessary to an intelligent understanding of engineering, but this taught thoroughly, so as not to be forgotten. This, however, requires a far higher grade of teacher than is needed for the mere memorizing of text-book matters, reciting them at the end of the term, passing an examination on the subject and then dropping it. The salaries offered by the colleges are not such as to attract such men. When the student enters college he is not receptive to an intelligent understanding, for after a four years' dose in the high school of the same vicious method of memorizing a large mass of half and even less understood matters, the student finds it far easier to memorize the contents of his text-books than to use his intelligence to understand the subject-matter. After graduation, years of practice do for the better class of students what the college should have done—teach them to understand things. It is, however, significant that even now young graduates of foreign universities, in spite of the inferior facilities afforded abroad, do some of the most important electrical development work of this country. Men who never had a college education rise ahead of college graduates. This would be impossible if our college training gave what it should, an intelligent understanding of electrical engineering subjects.

The cause of the fault is perhaps the same that leads to the erection of engineering buildings and laboratories while underpaying the teaching staff, the competition among the colleges. To the father who looks up a college for his boy, marble engineering buildings and fancy laboratories are impressive, and so is an extensive curriculum; the result is a rapid increase in the number of students; but it is not to the benefit of the student, since the faster a subject is learned the faster also it is forgotten, and to become and remain thoroughly familiar with a subject, it is necessary to keep up the study of it for some years. While it is a good feature to insure application of the student by term examinations, etc., this becomes harmful if it leads to dropping the subject at the end of the term. The least that can be expected from the college is that at the time of graduation the student still knows all that he has been taught during his college years. To accomplish this it is necessary to keep up the study of every subject to the end of the college course. This is not the case at present.

The different colleges vary between the school teaching the trade of electrician, and that attempting to give an intelligent electrical engineering education. At the one extreme is the college which dropped from its curriculum everything not required in electrical engineering. Such a school covers a large ground in electrical engineering, and may even consider shortening the course to three years. The graduate of such a course is a full-fledged electrical engineer, capable to ply his trade, just as a plumber or bricklayer when graduating from his apprentice years, and just as helpless and useless when any occasion arises requiring general knowledge to enable him to understand matters beyond his trade. The unavoidable result of such training is, that when with the development of the industry subjects become of importance which were not considered as pertaining

to the trade of electrical engineering during his college years, his usefulness is impaired, younger men rise above him, and he cannot hope to rise beyond a subordinate position. Fortunately, the better technical colleges realize that the first requirement of an electrical engineer is a thorough general education, and begin to realize that for this purpose it is not sufficient to require general subjects for college entrance and relegate their study to the high school; for even if the average high school were what it should be and not what it actually is, much of the general knowledge required by an educated man cannot be taught in the high school, since during the high-school years the intelligence of the boy is not sufficiently ripe for its grasp, and a review in the college is necessary.

However, even if an attempt is made to teach or to review general subjects, the work is not carried sufficiently far. Mechanical engineering, physics, chemistry and some civil engineering subjects are recognized as legitimate subjects of teaching in the electrical engineering course in many colleges, together with literature, some history, etc., but physiography, physical geography, meteoroiogy, mineralogy, astronomy, etc., are also of importance in a general engineering education. The failure to recognize this may sometimes be a severe handicap to the electrical engineer, and that in the not very far future, judging from the present trend of development. In this direction the student, as well as his parents, is frequently antagonistic, and cannot see why subjects should be studied, which, to his limited horizon, appear unnecessary.

The instruction given in those branches of science, a knowledge of which is required by the electrical engineer, but to which only a limited time can be devoted, as chemistry, civil engineering, etc., frequently is very unsatisfactory, being unsuited to the requirements of the electrical engineer, and, as result, of very little if any value to him. A general knowledge of these branches is required, so as to familiarize the electrical engineer with the general problems, methods and purposes of the science; to enable him to understand subjects dealing with these sciences. The ability actively to practice the science is not required. To illustrate in the case of chemistry: the electrical engineer should have a knowledge of the laws of chemistry, a familiarity with the elements and their compounds, and a general knowledge of the methods of analysis and synthesis. Such a course must, therefore, necessarily be largely descriptive, and the experimental work largely illustrative. The same course is frequently given to the electrical engineer as in the first few terms of the chemistry student; general inorganic chemistry of the most important elements, and qualitative analysis. While a first-class beginning of a course of chemistry, such a course leaves the engineer with a knowledge altogether too fragmentary to be of benefit to him, and the time spent in mastering the mechanism and the details of the qualitative analysis is largely wasted, since the electrical engineer will probably never be called upon to make an analysis. If he attempted to do so he would probably fail. The beginning of a chemist's training is not suited to the chemical training of the electrical engineer, and the same applies to all other sciences to which a limited time is devoted in the electrical engineering curriculum. To give a general view and working knowledge to the electrical engineer of such an allied branch of science, theoretical discussions, especially mathematical, are usually very little needed and, therefore, undesirable. A characteristic case of spoiling a science to the students by mathematics is that of astronomy. Astronomy is one of the most interesting and fascinating of subjects. But where taught as a part of the general educational programme, it frequently is all mathematics, and so hopelessly dry and repellent. It should be given descriptively, for in a short course on astronomy it is just as ridiculous to delve deeply into mathematics as it would be to start the teaching of geography with a course of spherical trigonometry. In the teaching of allied sciences our colleges and schools are still greatly inferior to those abroad; the result is very marked in the product of the colleges, in the inferiority of the general education possessed by our graduates.

It goes without saying that in all teaching the strongest endeavor should be made to correlate the different subjects, to show the students the close relations which exist between all the branches of science, no matter how different they appear at first sight, and to interest him by bringing home to him the practical importance of what otherwise would appear dry theory; for instance, by using in the teaching of mathematics, problems taken from engineering; to have him handle and operate machines before proceeding to their theoretical investigation, then to derive the constants of the theoretical investigation from experimental tests of the apparatus, and from these predetermine the performance of the apparatus under different normal and abnormal conditions and experimentally verify it.

In conclusion, the main defects in the present electrical engineering training in some of our colleges appear to Dr. Steinmetz as follows:

1. The insufficient remuneration of the teachers, which makes most of the best men unavailable for educational purposes and is, therefore, largely responsible for the other defects.

2. The competition between colleges, which leads to a curriculum marked more by the quantity of the subjects taught than by the thoroughness of the teaching. The graduates are sent out with a mass of half understood and undigested subjects, quickly forgotten and deficient in understanding of the fundamental principles and in the ability to think.

3. The tendency of some colleges to teach the trade of electrical engineering rather than educate intelligent and resourceful electrical engineers.

4. The unsatisfactory state of the teaching of allied sciences, which gives instead of general view and understanding of the science, a fragmentary knowledge of some details.

Interior Wiring Progress in the Rocky Mountain Districts.

By W. J. Canada.

The progress toward safety and permanency of inside electrical construction throughout the Rocky Mountain territory in the last 20 years has been marked by phases which are peculiar to a new, rapidly growing country, of natural wealth as distinguished from commercial wealth. The buildings have been erected in haste to meet emergencies, and hence embody many constructive defects, and especially defects in a form of construction so little understood generally as wiring for electricity. The building cost has often been kept down to figures which are the despair of architects. In other words, a reckless spirit has been here added to the very usual ignorance of what will produce safety and permanency in electric wiring.

This hurried and unstudied construction is still, so far as the better materials now on sale will allow, very frequent, especially in the newest towns. Firestone, a farming town of 400 inhabitants, for instance, has been in existence just seven months and is now installing a municipal street lighting plant and the 60-odd dwellings and stores are being wired for electricity by the cleverest "Jack of all trades." Cases of this kind happen many times each year, and practically all the towns and cities of this district had almost every building wired in this way. In other localities competitive bids for the town plant and the town wiring lower the class of construction, because supervision is not anticipated before the bills are paid.

The first attempts to bring about better electrical conditions were, as usual, made by the underwriters having jurisdiction. They were undertaken because of the large number of fires reputed to be caused by electricity. Doubtless many so reported were from other causes, but in the main the troubles were apparent, and the necessity for action clear. The remedy: standard materials and "Code" construction was also clear, but the method of application of this remedy was a question involving a great many considerations. From the difficulties experienced in eastern states in grappling with the problem, the many failures, and the growth of the electrical fire list, coincident with the increase in electrical applications, it was expected that at

least as much difficulty would be encountered in a more rapidly growing section. And here is where additional and almost unsurmountable difficulties arose. In an attempt to school an electrician in the comparatively safe construction called for by the Code, personal attention and supervision must be given to the individual installations. In a territory 1100 miles long and 400 miles broad, with poor railroad facilities and with the inhabitants scattered in a number of small towns or cities, the condition of personal supervision by the underwriters appears a thoroughly impracticable one in most cases.

In this belief the underwriters applied their first efforts to the adoption of ordinances governing electrical construction in the larger cities. In this they were successful in that such ordinances were passed in Denver, Pueblo, Colorado Springs, Trinidad, Boulder, Fort Collins, Longmont, Loveland, Fort Morgan, Silverton, and in some other cities clauses requiring "Code" construction were inserted in the building laws. The success of these ordinances has varied greatly.

In Denver this plan of supervision first fell into the hands of politicians and was discredited at once as ordinary graft. Conditions were bettered somewhat by the class of material pushed by supply houses who were not aware of the real conditions of supervision. In 1903 wiring conditions had become so unbearable that the interest of the general public was enlisted and the appointment of a competent and honest inspector was secured. Despite political enemies, and those enemies gained by the honest enforcement of the ordinance, he obtained amendments in the ordinance to allow for a sufficient number of inspectors and a fee system for supporting the increasingly expensive inspections, with the result that electric installations were put in better than ever before. Many serious mistakes were made in the interpretation of the "Code" by this department, but the tendency was good, and has been improving gradually ever since.

Denver now stands in a very advanced position as to its electrical construction. It possesses a large, well equipped inspection department, that inspects every new wiring installation and posts a notice before work can be concealed. Except in special classes of wiring, the quality of installation is now excellent. The ordinance requires the wires in all new buildings, except single dwellings, to be installed in iron conduit, and thus eliminates the frequent troubles from careless plumbing or other repairs on knob and tube wired buildings. Outside wiring on or against buildings must now be placed in conduit and signs are required which meet the conditions in the "Code." When it is considered that Denver has more display outline and sign lighting, per capita, than any other city in the country and that most of this obtained by a free installation—low flat-rate contract proposition, the former construction being open wiring and wooden molding, the above gains in construction may be considered very encouraging to many a city facing a similar problem.

Other good advances have been made in Denver during the last six months. The Rocky Mountain Fire Underwriters' Association has recently established an electrical department and obtained an engineer of experience to assist in cutting down electrical hazards in the territory. Theatre wiring had never been given special treatment. The Denver city department had been recommending knob construction and scatter cut-outs, and the moving-picture machine hazard, which has become so prominent of late, had received scant attention. Since the beginning of the year every moving-picture machine in Denver has been made to conform to the Code requirements, and is regularly inspected by the city authorities. The operator must be a licensed electrician, and the whole matter, including booth specifications, is cared for by a city ordinance. This practice has extended to all the cities of the state. Theatres are now being wired in conduit, and the Majestic, just completed, fails only in minor details of being in accordance with the new rules for theatre wiring. Other theatres are being rewired to meet the new conditions.

The contractors of Denver have in general been somewhat slow to adapt themselves to the new methods of wiring, principally because the city inspectors have been chosen from workmen whose entire experience has been gained in Denver. This has resulted in the persistence of several serious faults. The needs of Denver are now not far from those of the ordinary city of its size. It has had a somewhat longer period of inaction as to supervision than most Eastern cities, and a consequent larger number of buildings exist whose wiring is a continual trouble and a constantly increasing fire hazard. Where such buildings have additional wiring installed, the political difficulties of either securing a rewiring in safe and permanent manner, or of refusing permission to install additional wiring, have been great. The fee charged has probably contributed to this bad condition, which will be remedied by causing all the additions in buildings already wired to be installed as separate circuits from the point of distribution. At present the methods of installing additional wiring are haphazard, and frequently result in overloading the original system.

Show-window wiring is mostly in molding and a canvass of some 180 stores using this window construction recently revealed the fact that in 34 cases tacks, nails or screws were hammered in the molding and in most cases pierced the insulation. The flat-rate plan of the electric light company offers some difficulty in the way of bettering window conditions in old buildings by installing conduit, as the rate would need to be increased.

It is due the Denver Gas & Electric Company to note that its effort has been to get permanent and safe construction in all cases. When the city department was first started its loose methods met with strong opposition from this company, but the management has been for some time thoroughly in harmony with all movements toward better installations. The company has begun a systematic grounding of secondaries. The business-getting force is well schooled and instructed to recommend only safe devices, and frequently consults with the underwriters on special matters. That a pursuance of such a policy is compatible with the best financial results, a comparison of Denver's connected load per capita with that of any other city in the country would readily prove.

In Pueblo a very different set of influences has been at work and electrical wiring conditions are poor and unpromising. For three years an ordinance has required all wiring to be in accordance with the National Electric Code. This ordinance has not been rigidly enforced, however. There is a large motor load throughout the city still connected to a grounded railway circuit, and giving frequent trouble. The cost of wiring is also excessive.

The result of such a situation is an under-lighted city, a low appreciation, if not distrust, generally of wiring, and a comparatively low connected load per capita. There is a probability of a crusade for permanent wiring construction and better protection. A recent rerating of the city under the analytic schedule of rating, which brings the defects of building construction into prominence and makes corrections of these defects a condition of lowered insurance rates, has given an additional impetus to this public movement. The public press has also done much in this direction.

Colorado Springs is undergoing the same impulse toward good permanent construction. The development has been very great in wiring construction during the past year. But here the contractors have been very progressive, both in handling high-grade materials and in demanding careful workmanship from their wiremen. Outside wiring has been greatly improved, and the electric light company has given the best support to all movements of this kind. In Colorado Springs the fire chief, who is the official electrical inspector, by frequent consultation with the underwriters' electrician is obtaining safe and permanent construction of new wiring.

Trinidad was once poorly wired and many installations were hazardous. This condition was largely due to the competition of two antagonistic service companies and the incompetency of the wiremen in general. A general electrical inspection of the city brought these conditions strongly to the attention of the public. Since that time the worst feature of the situation has been eliminated in that the Las Animas Light & Power

Company plant has been discontinued, and the wiring has been done by wiring contractors, who have shown a real interest and a steady improvement in the class of their work and in the materials used. The city's ordinance, which includes the National Electric Code, is being enforced by the fire chief. Now many of the more important buildings are rewired in standard manner, and several are wired in iron conduit. The outside conditions have been improved in many respects, at the suggestion of the underwriters. At present several buildings are under construction and are being wired in iron conduit throughout. An intelligent city government and the strong protest made by the underwriters against conditions have here been productive of the best results in wiring.

A general campaign throughout Colorado, Wyoming and New Mexico has been made by the Rocky Mountain Fire Underwriters' Association, especially in Colorado, east of the mountains, where some supervision is possible. The results have been especially good in the "Horn" cities, Boulder, Longmont, Loveland, Fort Collins and Greeley, where a previous campaign by the same association had already procured ordinances. In these cities, local inspection is at present discredited, and the more important building contractors require the inspection of the underwriters. The gains in these towns have been in the practical abolishment of unapproved materials and practices.

A general tendency toward better and more permanent wiring and the supervision that produces this result has been growing. The establishment of an electrical department by the underwriters has assisted this growth. A number of bulletins have called attention to prevailing conditions, and these bulletins have been followed by correspondence on the general condition, on individual building installations, and frequently by personal inspection by the underwriters' electricians, and explanations of defects to wiremen, service companies and city councils.

Improvement has been rapid in the newer installations in all the territory where actual inspections have been made in this manner. In Cheyenne the action of the city authorities has been a very positive one. A number of the worst buildings, electrically, have been condemned by the city engineer and the wiring ordered reinstalled. Moving-picture machine shows have been given a limited period within which to install standard booths for their machines and the necessity brought sharply before the contractors to make their electrical installations in a standard manner.

There is a very pronounced increase in the number of grounded secondaries all through the Rocky Mountain region, because a number of deaths and accidents to persons, as well as some property loss, have been traced to ungrounded secondaries. Some opposition to grounding has been experienced, however, owing to a somewhat prevalent belief that grounding invites transformer troubles.

In the way of fires the territory offers great obstacles to the gathering of statistics. Out of a number of mining property fires, none was reported as originating from electrical causes. Eight electrical fires in Denver, four in Pueblo, one in Trinidad, and some six scattered about the states make the list. The most frequent cause was the wearing away of insulation against pipes and other wires, seven fires resulting from this cause. Four fires were due to melted fuse wire, where fuses were not enclosed in cabinets. Three fires were caused by the films of moving-picture machines. The remainder were from scattered causes.

The educative influence of the central station company is of prime importance, and as control of these companies is being gradually centralized and vested in interests which employ engineers of ability and far-sightedness, the impetus given by the underwriters is assisted greatly by the service company's advertisements and example. The most advanced position in this regard on the part of the electric light company, that of not connecting to any installation which has not received the approval of a thoroughly competent and disinterested inspector, has been practically impossible in the smaller towns.

The main business of a central station company, is, of course, to make reasonable returns on capital invested by the sale of electricity and to increase this return by any legitimate means. The main interest of the wiring contractor is to realize fair profits from the installation of wiring. The increase of business for both is to be obtained in the satisfaction of its customer. The interest of the public is almost invariably to obtain both wiring installation and subsequent service with their least respective cost. It has required a certain education for each of these interests in the past to bring them to a point where each respects properly the position of the other. In the less developed localities this respect is often confused with a general cheapening of electrical construction to a point where the danger from fire is unreasonably excessive. Under such conditions the underwriters have frequently been compelled apparently to antagonize all these interests, in demanding a better class of materials and more care in installation. This, by increasing construction costs, may for a time operate to hamper the sale of energy, to curtail the amount of electrical construction and to appear to burden the property owner. The proof that this is a mistaken belief is to be found in the much greater proportion of energy per capita, the more frequent and lucrative calls upon the electrical contractor, and the final satisfaction in safety and permanence of construction by the public, in those cities where electric wiring is most carefully supervised and where the Code standard is most fully observed.

Electrical Development at Jackson, Miss.

The year 1907 was a remarkably favorable one for the growth of electric motor application in Jackson, Miss. At the beginning of the year the Jackson Electric Railway, Light & Power Company had little or no motor load of consequence. Jackson is a residential city of about 30,000 inhabitants; it is the capital of the state, and has a considerable commercial development, but comparatively few manufacturing plants. By aggressive campaigning for new motor business during the year about 300 horse-power in connected load was secured in a total of about 18 installations. The power plant is a steam turbine station of 1000-kw rated generating capacity, Illinois slack coal being burned under three 350-hp boilers. The motor rates begin at 10 cents per kw-hour, and a sliding scale is in effect which somewhat more than cuts this two-thirds in the case of very large consumption. All the energy included in the above total is furnished by 220-volt, three-phase induction motors, and the variety of the service illustrates how much can be made of motor business in a small city whose main interests are not in factory work.

Representative installations made during the year are headed by an 80 horse-power application of motors in the plant of the Central Cottonseed Oil Company. In this establishment a cotton gin is driven by a 50-hp motor, a round bale press by a 25-hp motor, and a ventilating outfit by a 5-hp motor. The reduction of standby steam losses to zero and the convenience of the electric drive in this case have been so gratifying that the future of electricity in this branch of the cotton industry is undoubted. At the works of the Mississippi Fertilizer Company, a closely related industry bearing upon the work of cotton raising, a saving of about 50 per cent over the cost of operation by steam engine has been experienced. A 25-hp motor in this plant drives the mixing outfit. Aside from the saving in fuel cost, there has been a material reduction in labor cost, and the convenience and absence of idle depreciation are significant in face of the fact that the plant seldom runs over four months in a year.

The Mississippi Seating Company, makers of school furniture, installed 15 motors, aggregating 72 horse-power, early in the year. These machines vary from 2 to 15 horse-power each and drive special woodworking tools by individual belts. Other applications are in saw and planing mills, in bakeries driving dough mixers, in bottling works driving bottle washers and carbonated water pumps, in a carriage factory, mattress shop, and for forcing gas from retorts into the holder at the local gas works. A number of printing establishments and the daily

papers enjoy press and linotype drives by electricity. A 20-hp motor is in service driving pattern-making tools in a foundry, and in one of the large public schools a 10-hp ventilating fan drive has been installed.

The company expects shortly to be in shape to handle a large increase of business, and at the present time a second 500-kw Curtis turbine is being installed at the generating station on Tombigbee Street. The average 24-hour load upon the plant is now about 300 kilowatts. Mr. F. G. Proutt is at present general manager of the company.

The Law of Electric Light Companies.

By JOHN E. BRADY.

THE use of public streets and highways for the distribution of electricity for lighting purposes is essentially public in its character, and it is a use to which the streets and highways may very properly be devoted. State vs. Murphy, 134 Mo. 548. Nevertheless, the consent of a municipality is generally made necessary by its charter or by a general statute before its streets can be used either above or below the surface for the purpose of running electric wires. A. & E. Encyc. of Law, Vol. X, p. 866. In the State of Massachusetts there is a statute which provides that "in any city or town, in which a company is engaged in . . . the manufacture and sale of electric light, no other company shall lay or erect wires over or under the streets, lanes and highways of such city or town for the purpose of carrying on its business, without the consent of the mayor and aldermen." A company, which was organized after the enactment of this statute, proceeded to place its poles and wires in the streets of the city of Boston, without first having obtained this consent, and in an action then brought to restrain the company from furnishing electric light it was claimed for the defense that, the company having succeeded in putting its lines in running shape, it could not be restrained from using them, as the statute prohibited only the erection of the poles and wires and made no reference to using lines already up. The court refused to make such a distinction and held that the prohibition to put up the electric light lines amounted to a prohibition to use them after they were constructed. It was then claimed that the company did not come within the meaning of the statute as it was not engaged in the business of selling electric light, but was merely selling electricity, inasmuch as the apparatus at the customer's end of the system was in each case owned by the customer. But this was also too finely drawn a distinction for the judicial mind of the court and an injunction against the company issued. Attorney-General vs. Walworth Light Company, 157 Mass. 86. It has been held that the right to lay gas pipes does not include the right to erect electric light appliances. The city of Newport, Ky., granted to a corporation the privilege of using the public streets for the purpose of laying gas pipes to supply the city and its inhabitants with gas light and it was provided in the act which conferred the privilege that the company might adopt any other means equal to the means for supplying gas, provided the same could be done at no greater cost to the city. Under this authority it was held that the company did not have the right to use the streets for the erection of appliances necessary for the introduction of electric lights, and that, if the company wished to embark in the electric light business, it would first have to gain the consent of the proper municipal authorities. Newport vs. Newport Light Company, 89 Ky. 454.

VESTED RIGHTS.

It is possible for an electric lighting company to gain a vested right in the streets of a municipality, one which neither the municipality, nor any person acting under its authority, can destroy or interfere with. Where a municipal corporation, acting with lawful authority, grants to an electric lighting company the privilege of placing its poles and wires in the streets of the municipality, and the company proceeds to expend money in the erection of its works upon the faith of such license, the company gains a vested right to the use of the streets which the municipality cannot impair. A. & E. Encyc. of L., Vol. X, p. 868. In Rutland Electric Light Company vs. Marble City Electric Light Company, 65 Vt. 377, the plaintiff company, in 1886, had entered into a contract with the trustees of the village of Rutland, under which it erected its lines and commenced business. Subsequently, the defendant company, by permission of the trustees, erected its poles, in some places very near those of the plaintiff, and placed its wires in such close proximity to those of the plaintiff, which carried 110 volts, that during severe storms or in case of accident there was considerable danger of contact between the wires of the two corporations. And, as the defendant employed a different system of lighting, its wires carrying a current of 1000 volts, which was reduced where the wires entered buildings by the usual appliances, a contact between the two sets of wires was very likely to result in damage for which the plaintiff company could be held liable. It was held that, the village having granted, by competent authority, the right to install the plaintiff company's system, and, the company having acted upon that authority to the extent of placing itself in position to carry on business, the company had acquired a vested right in the streets of the village, which the latter could neither revoke nor interfere with. An injunction was accordingly granted enjoining the defendant company from maintaining its wires so as to impair the service of the plaintiff.

In the case of Lewis vs. City of Newton, 75 Fed. Rep. 884, it appeared that the city had granted, by duly enacted ordinance, the privilege of erecting "such poles and wires as may be necessary to transmit electric power and incandescent electric light," and it was held that, inasmuch as the city had not reserved the power to withdraw the privilege, the ordinance could not, in the absence of constitutional or statutory authority, be repealed or modified by the City Council.

EXCLUSIVE RIGHTS.

Unless the Legislature has bestowed upon a municipal corporation the requisite authority, the municipality cannot grant to an electric light company the exclusive right to use its streets for the purpose of supplying electric light to the municipality and its inhabitants. The proposition is supported by the case of State vs. Murphy, 134 Mo. 548. As shown by the facts in that decision, the city of St. Louis, having power under its charter to "regulate" the use of its streets, enacted an ordinance purporting to grant to an electric company the right to occupy the streets of the city for a period of 50 years by subways and equipments necessary to install wires "to be used for the transmission of electricity for any and all purposes." The evidence showed that the object to be accomplished in granting this important franchise was to vest in one company the right to build suitable conduits and to require all telegraph, telephone and electric light companies to lease the use of the wires from the favored company or its successors. As the ordinance stood the company was under no obligation to permit any electric light or other company to make use of the wires and it was thus given the right to control the use of the streets in this manner for its own private benefit. At the time of the grant, the company was not engaged in the business of transmitting electricity for lighting purposes, or for any other public purpose, and the ordinance did not require that the company use the privileges for the benefit of the general public, nor was any right of control over the works of the company reserved. It was held that the grant was for a private use and, therefore, invalid. Julia Building Association vs. Bell Telephone Company, 88 Mo. 258. Under the power to regulate its streets a city has the power to permit their use for the erection of poles and the stringing of wires, or for the installing of conduits, gas pipes, etc., so long as exclusive privileges are not granted. In the case above referred to it was contended that inasmuch as the company had gone to great expense, with the knowledge of the city, in constructing its subways the city ought not to be allowed to deny the validity of the franchise. This argument would have been good but for the fact that the granting of the franchise in such exclusive form was an act entirely beyond the powers of the city. The rule is that where a municipal

corporation enters into a contract which it has the power to make, the doctrine of estoppel applies to it with the same force as to a private individual. By virtue of its general power to regulate the use of its streets a city may lawfully permit uses, which do not materially interfere with the public travel upon the streets. But a city may not authorize the appropriation of any part of its streets for private purposes. In another instance, the city of Grand Rapids, Mich., having the power by its charter to make, amend and repeal any ordinance deemed desirable for lighting its streets, but not having, by express grant, exclusive control of the streets, passed an ordinance attempting to grant to the Grand Rapids Electric Light & Power Company the exclusive right to use the streets of the city for a period of 15 years. It was held that the city had no power, express or implied, to give an exclusive right in its streets. Such a right could only be granted by the sovereign power of the state, or by the municipality, in case the power had been granted to it by the state. Grand Rapids Electric Light & Power Company vs. Grand Rapids Edison Electric Light & Fuel Gas Company, 33 Fed. Rep. 659.

In Crowder vs. Town of Sullivan, 128 Ind. 486, it appeared that the State of Indiana had conferred upon the municipal corporations within its jurisdiction authority to contract for electric lights. Under this authority the town of Sullivan passed an ordinance which, it was claimed, granted an exclusive right to an electric light company. In passing upon the validity of the ordinance the court said: "It is unquestionably true that a municipal corporation cannot grant to a private corporation the exclusive privilege of using its streets for the purpose of supplying the corporation or its citizens with light, water, fuel or the like. If the ordinance before us is to be construed as granting an exclusive privilege it must be adjudged void insofar, at least, as it attempts to make such a grant."

CONFLICTING RIGHTS.

It often becomes the duty of a court to decide which of two electric companies, both of which claim the right to the use of the same street, has the prior right. The general rule is that, where a company, which, in the operation of its business, uses wires for the transmission of electricity, has, with the requisite authority, occupied a reasonably sufficient space for its works along a street border, it thereby acquires the right not to be molested in its possession. The company first occupying the street, however, cannot claim more space than is reasonably sufficient for the safe and successful operation of its works. A. & E. Encyc. of L., Vol X, p. 867. Consolidated Electric Light Company vs. People's Electric Light Company, 94 Ala. 372. In the case cited it was said: "Monopolies are not favored and are never sanctioned unless a necessity for their tolerance is shown, or unless the necessity springs out of the very circumstances of the case, or the transaction." In an action brought by a telephone company against an electric light company to enjoin the latter company from erecting its poles and wires upon the same streets with those of the telephone company, the evidence showed that the electric light company, after the passage of the ordinance which authorized it to use the public streets, decided upon what streets it would occupy and submitted the proposed plan to the officers of the telephone company who pronounced it satisfactory to them. The electric light company then commenced the work of erecting its poles and shortly afterwards the telephone company began to place its poles upon the same streets and sought to oust the electric light company. It was held that the electric light company, having been the first to occupy the street, was entitled to remain. Nebraska Telephone Company vs. York Gas & Electric Company, 27 Neb. 284.

RIGHTS OF ABUTTING OWNERS.

The great weight of authority is to the effect that an electric light company cannot erect its lines along a rural highway or country highway without first gaining the consent of the abutting owners or acquiring the right by the process of condemnation. The proposition is supported by the decision in the case of Palmer vs. Larchmont Electric Company, 6 N. Y. App. Div. 12, where the question was presented whether an electric company, having a contract with the proper town authorities to light a public highway, might erect poles and wires upon the highway without the consent of the abutting owners. The question was decided in the negative and the decision was based upon the fact that the fundamental idea of a highway is a place for the uninterrupted passage of men, animals and vehicles, and to afford light, air and access to the property of abutting owners; that, in the latter respect, an abutting owner has a greater interest in the highway than the general public; and that, consequently, any permanent or exclusive use of any part of the highway by any person or corporation is illegal. In the opinion the court said: "A pole which supports wires cannot, like the underground pipe, be placed in the roadway, nor can it stand on the sidewalk if there be such. From necessity it must be placed between the two or upon the side of the roadway where the owner has substantial rights. Unlike the lamp post, the hitching post or the hydrant, it does not occupy a small space, but it carries wires along the whole length of the street. It intereferes (in a small degree, perhaps) with the access to the property. But it does interfere with and perhaps destroys the legal right of the owner to plant and grow shade trees and to use the side of the road, and the use made of the street is of a permanent and exclusive character. As was said in Eels' case: Such a use is 'wholly at war with that of the legitimate public easement in the highway.'"

On the other hand when the question has come up with reference to the right of an electric light company to occupy a city street, it has been held that it may do so, with proper municipal permission, without compensating the owner, unless it is the intention of the company to supply light to private persons only and not to furnish light for street illuminating. In a Montana case it appeared that an electric light company, which had a contract with the city of Butte to light the streets of that city, erected one of its poles in the middle of a sidewalk about 20 ft. from the entrance to a saloon. The pole did not interfere with the light or air to the saloon, or the access thereto, but the proprietor wished to have it removed and brought an action to accomplish that purpose. It was held that the erection of the pole in a city street was an act of which the abutting owner could not complain. This distinction between urban and rural highways was recognized in the case of Johnson vs. Thomson-Houston Electric Company, 54 Hun. (N. Y.) 469, where it was said: "It must be admitted that the streets of a populous village or city are subject to greater burdens and to a greater variety of uses than a rural highway, and that the extent of an easement in a street is to be measured by the necessities of the public." But, in a recent Court of Appeals decision (Osborne vs. The Auburn Telephone Company, New York Law Journal, Nov. 13, 1907), it has been held that the owner of the fee in a city street may restrain a telephone company from placing its poles in front of his property. And there is no apparent reason for believing that the decision would have been different had the party in interest been an electric light corporation instead of one engaged in the telephone business. In fact, it was said in Palmer vs. Larchmont, supra, with reference to the rights of abutting owners against companies appropriating the highway for the placing of poles: "Upon that theory of the law it is impossible to make any distinction between poles intended to carry telegraph or telephone wires and poles intended to support electric light wires." The Auburn Telephone Case, cited above, appears to be in conflict with previous decisions, for there the court said: "The learned Appellate Division appears to have entertained the view that there was a distinction between rural and urban property. It is undoubtedly true that the use of highways is many times greater in cities than it is in country towns. We had occasion to consider this question to some extent in the case of Palmer vs. Larchmont Electric Company, and in addition to what we then said we only wish to remark that the fee to lands in the city is as sacred to the owner as it is in the country, and that in either place he is protected by the constitutional provision to the effect that property shall not be taken for public purposes without compensation."

Electric Elevator Conditions in the New England Central Station Territory.

ONE of the most perplexing problems in connection with central station service over wide areas of distribution is the sale of electricity for elevator motors. From some points of view, the elevator motor is not an unmixed blessing to the central station manager, particularly if it must be supplied off a lighting circuit of modest cross-section. The farther one goes from the generating plant, the more difficult becomes the problem of profitable supply of energy. On the other hand, in some industries electric elevators are operated mainly during the hours when the lighting load of the station is lowest, and in such cases the load can be generally made profitable if the rates are calculated with care and are well maintained. In order to secure the points of view of a number of central stations in New England and vicinity upon the electric elevator problem, inquiry was made as to the conditions prevailing at the present time among several active operating companies, and the results of this investigation are summed up in the following paragraphs.

In answer to the inquiry whether an electric elevator load is considered desirable the Lowell Electric Light Corporation; the Narragansett Electric Light Company, of Providence; the Salem Electric Light Company, and the Montreal Heat, Light & Power Company emphasized the importance of supplying energy for elevator motors from circuits independent of the lighting mains and branches, and the Salem company stated that it had never experienced any trouble or interference from electric elevator service with its lighting or motor load. The Haverhill Electric Company, the Malden Electric Company, and the United Electric Light Company, of Springfield, Mass., did not consider the elevator business desirable. The Worcester Electric Light Company has very little load of this kind, as most of the elevators in that city are run by water. Worcester does not compete with water power, but charges the regular motor rates for what little elevator service exists. It is not considered a desirable load under the conditions prevailing at Worcester.

The connected elevator motor loads are about 100 horse-power at Springfield; three installations of 10 horse-power each at Malden; 140 horse-power at Salem; 2500 horse-power at Montreal, and 250 horse-power at Haverhill. In the latter city there are some 30 installations, mostly in shoe factories. The motors are in constant use, running all the time. The only company that feels the effect of the elevator load at special hours is the United Electric Light Company, of Springfield, which notes a considerable load at the time when the office buildings of the city close, about 4:30 to 6 p. m. The elevator service in the city of Pittsfield, Mass., is almost entirely hydraulic, the pumps being driven by 500-volt, direct-current motors. The Pittsfield Electric Company has a connected load of about 50 horse-power for elevator service, charged at regular motor rates ranging from 3 cents to 4 cents per kw-hour. As the pumps run continuously and are automatically by-passed, the load is steady. Few unusual conditions were found in the installations. The Salem Electric Lighting Company, however, has one large lift in a storage warehouse.

In Springfield, electric elevator motors are allowed on 500-volt, direct-current circuits; in Salem, a few direct-current elevator motors are running, but all new motors must be designed to use alternating current; the direct-current elevator motors will soon be changed. In Malden and Haverhill, all electric elevator motors are supplied with energy from three-phase motor circuits. The Montreal Light, Heat & Power Company allows elevators on both alternating-current and direct-current circuits, as do the electric light companies at Lowell and at Providence. Little restriction exists as to hours of use. In Salem, the use of electric elevators is expected to stop between 10 p. m. and 7 a. m. The companies at Springfield, Malden, Haverhill, Providence, Montreal and Lowell furnish continuous service for elevators.

Elevator motor rates at Montreal are $50 per horse-power per year for direct-current passenger service, and $40 per horse-power per year for alternating-current freight service. These rates are based on the average maximum of starting current and running demand. In Lowell the rates are 10 to 7 cents per kw-hour. In the past all the elevator motors in Montreal have been supplied on a flat-rate basis, but a new basis of charging by meter will soon be in use there. The new charge will probably be in the nature of a readiness-to-serve and a meter charge, the idea being to base the readiness-to-serve charge on the rated capacity of the motors, while the meter charge will be determined with regard to the peculiar load-factor conditions which obtain in elevator motors. In Lowell the rates are based on the tested starting current. In Providence no special rates exist for elevator motors. The charge for energy for motors is 10 cents per kw-hour, with a sliding scale of discounts. Where other energy is used by the same customer, gross bills are combined for purposes of discount. Tests of starting current are not used in Providence as a basis of rates. In Springfield the rate for energy for elevator motors is about 4 cents per kw-hour. It should be borne in mind that the Springfield and Montreal companies enjoy in a degree the advantages of water-power generating plants, the latter city depending almost entirely upon the transmission of electricity from hydro-electric stations. The Malden and Haverhill companies charge the standard motor rate for energy for elevator service. In both these cities the rate is made up with a service charge based on the maximum demand ascertained by Wright demand meters. The Salem company, depending on steam plant production, charges 6 cents per kw-hour for energy for elevator motors; this, however, the management considers too low a rate. In Springfield all the energy is metered.

The United Electric Light Company, of Springfield, competes with other kinds of elevator service by showing a lower cost of operation. The company does not advertise for elevator business, however. A hotel elevator load is here preferred to one in an office building or a residence. The Narragansett Electric Light Company, of Providence, solicits elevator business the same as other motor load, making no distinction between elevator and other business. The company competes with the hydraulic and steam elevators by obtaining all the other load in the building and making it impracticable to maintain steam boilers for elevator service alone. Water rates are too high in Providence, and the pressure too low to operate elevators from city water economically. The company does not object to electro-hydraulic elevators. It prefers the office and hotel load. The Salem Electric Lighting Company does not advertise for elevator loads, has no competition to face, and takes any kind of load it can obtain. The Malden Electric Company and the Haverhill Electric Company do not have much competition in the elevator field, and make no special effort to meet it. The Lowell Electric Light Corporation advertises for and solicits elevator customers. In competing with steam and water, the company endeavors to furnish a motor to pump the water if it cannot get the contract otherwise. The Lowell Company prefers the office building type of load. In Montreal practically all the elevators in the city are electrically or hydro-electrically operated. The company does not have any preference as to the character of the installation.

In regard to running special circuits for elevator motors, the Montreal Company will run a separate outside connection, but not a special circuit. The Lowell Corporation would wire separately, possibly, under extreme conditions, and the Providence, Malden, Salem, Haverhill and Springfield companies would not put up separate lines. Alternating-current elevator motors are in service in Providence, Lowell (in factories), Montreal, Salem, Malden and Haverhill. All electric elevator motors in Springfield and Worcester are of the direct-current type, and a few direct-current machines are in use in Haverhill. The alternating-current elevators are doing good work in Malden, Salem, Haverhill, Providence and Lowell. The companies at Lowell, Providence, Montreal, Malden, Haverhill and Springfield do not install elevator motors for customers, but the Salem

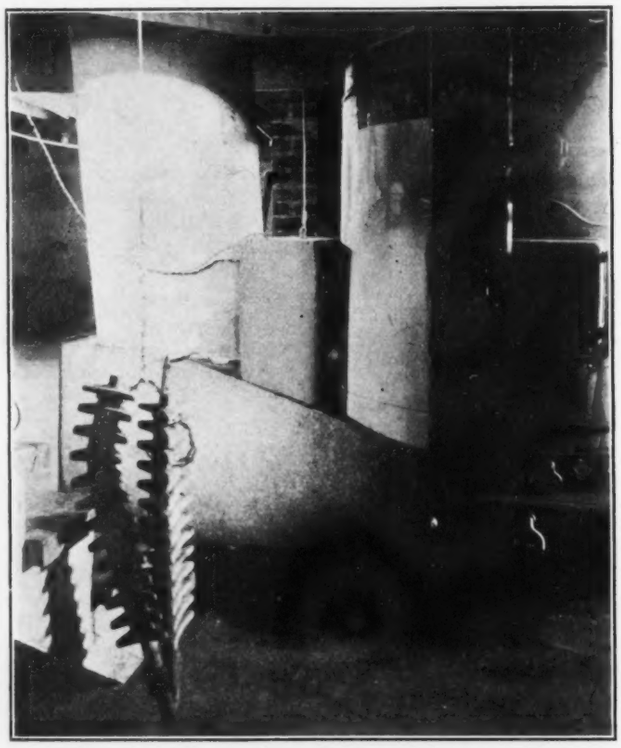
Electric Light Company handles this kind of business. Little demand appears to exist for electric elevator service in suburban territory. The Springfield Company would not attempt to supply a suburban elevator service; the companies at Malden, Lowell and Haverhill have no demand, while the companies at Providence and Montreal would supply alternating-current service for this class of work. The number of stories in the highest building supplied with electric elevators in the various cities is as follows: Providence, 12; Montreal, 10; Malden, 4; Haverhill, 8; Springfield, 6; Lowell, 6, and Salem, 4. Practically all the companies make no distinction between elevators and hoists, except that the Montreal Company counts a hoist as a freight conveyor. The Providence Company's sliding scale discounts vary from 5 per cent off $14 to 45 per cent off $70 on a 5 horse-power basis, and from 5 per cent off $14 to 45 per cent off $100 on a 10 horse-power basis.

Summing up the electric elevator situation as evidenced by the above notes, it would seem that there is room for a closer standardization of practice in this field. Given the proper rates adjusted to the commercial considerations of distance of load from centers of distribution, magnitude of starting current and average demand from the supply system, time of use, and competition with steam and water power, it ought to be possible to work out a satisfactory charge, and it is certainly desirable to secure this class of business. In the smaller cities the electric elevator problem is of comparatively small moment, and it is only in the cities where high buildings are multiplying that the question broadens out into a special branch. No central station company will make a mistake in accumulating a considerable quantity of data in regard to its elevator motor practice, for there is money to be earned in supplying these motors with energy at equitable rates. It is gratifying to note the entrance of the alternating-current motor into the elevator field, and this means whenever a suburban territory demands elevator service, it can be given it without prohibitive cost of copper in the supply circuits. The three-phase motor is widely applied for factory elevator service in connection with stations generating alternating current only, but the single-phase motor is already crowding the three-phase machine in some localities. The future of the electric elevator seems assured, but more technical data are needed as to the conditions of service, cost of operation and profit to be derived from given installations. Acknowledgment is hereby made with thanks for the courtesy of the companies mentioned in supplying the foregoing information.

A Good Arrangement of Furnace Fan.

The use of small fans for assisting the air circulation in hot-air furnaces has been frequently described and otherwise referred to in this paper. This is destined to be a very important application of electric fans, especially in the Northern States. The principal use of the fan in the furnace is to shorten the time required to bring the house up to a comfortable temperature in the morning after it is cooled down during the night. By forcing the circulation of air through the furnace and up through the hot air pipes and registers, the time required to bring a house to a comfortable temperature in the morning in practice is found to be about half that required with natural circulation. Aside from the comfort this involves, it makes possible considerable saving of fuel, because the furnace fire does not have to be worked with drafts wide open and excessive heat losses up the chimney for as long a period as otherwise. It should be clearly understood that the fan is not used in any way to force the fire, and in no way affects the temperature of the fire. It simply increases the rapidity of circulation of hot air around the furnace shell and up through the hot air pipes and registers, causing more heat units per minute to be taken from the hot inner shell of the furnace and transferred into the rooms of the house.

The place for the fan is in the air intake pipe of the furnace. The illustration herewith shows one of the best arrangements of furnace fan that has been suggested. The fan, which is an ordinary desk motor fan, is placed inside of a box. One side of the box is open, except where it protrudes out of the cold air box, and the other side is closed with a piece of sheet iron, except for a round hole the size of the fan which is directly in front of the fan. The object of this is to prevent the air forced by the fan from coming back in eddy currents around the sides of the box and so reducing the amount of air delivered to the furnace. The box in which the motor is placed slides up and down in guides and is provided with wire cable, pulleys, and a counterbalance weight so that it can be easily raised or lowered. In the illustration the fan box is shown raised out of the cold air box in the position in which it should be when the fan is not in operation. The air is then circulating naturally through the furnace. The reason for hoisting the fan out of the cold air box when it is not in operation is in order to avoid obstructing the cold air box with the fan box. For example, if a 12-in. fan is used only a 12-in. or 13-in. circular opening would be provided for the natural circulation of air with the fan lowered in place, because the rest of the opening is closed by the sheet iron. This would not be a sufficient opening for the proper natural circulation of air without assistance from the fan. The counterweight, consisting of scrap iron, can be seen in the foreground. In this particular case a 16-in. fan is used, and on account of its size, the motor had to be turned base upwards and screwed to the top of the box rather than to the bottom. A 12-in. or even a 9-in. fan is sufficient, however, for any ordinary hot-air furnace, and is to be recommended rather than a 16-in. fan because of the smaller amount of energy required and the greater ease of getting it into a cold-air box. It would, of course, be possible to make a further refinement of this arrangement, so that the motor could be raised and lowered by a chain from upstairs. The raising and lowering could also operate a switch which would put the motor in operation when the box is lowered, and out of circuit when the box is raised.



FURNACE FAN RAISED OUT OF USE.

Besides the use of the fan in shortening the time required to heat a house in the morning, it is also very useful when there is difficulty in heating certain rooms on the side of the house against which a strong wind is blowing. With a fan the air can be thrown into these rooms so that they can be heated when other means fail.

Electrically Operated Switchboards.

By S. Q. Hayes.

In practically all alternating current generating stations of a rating of 10,000 kilowatts or over, and in many smaller ones, it has been found necessary to control the main circuits by electrically operated switches and circuit breakers, owing to the amount of energy to be handled, the number of circuits to be controlled, the high voltage used, the advisability of concentration or for other reasons.

Such a switching equipment can be considered most readily under the following divisions: (1) The panels, desks, pedestals, etc., on which the controlling devices, instruments, etc., are mounted. (2) The circuit breakers, switches and controllers with the detail devices used in connection with such an equipment. (3) The arrangement of the structures for circuit breakers, bus-bars, etc., in the station, and the relative location of generators, transformers, feeders, etc.

This article will deal with the first division, viz., the panels, desks, pedestals, etc., and will take up some recent examples of such equipments to illustrate what has been done in this line, as well as some older ones to show the evolution of the designs.

Almost invariably the control apparatus, meters, etc., are mounted on slabs of marble or slate which form the panels, top of desk, face of pedestal, etc., although in some instances the entire switchboard, desk, etc., has been made of steel or other material.

The material of these panels, when of marble, is usually of the grade known as blue Vermont or blue Florentine, although occasionally white Italian or pink Tennessee is used. This is ordinarily bevelled and polished, although often enameled or provided with marine finish. Slate is almost invariably enameled or given a dull black oil or marine finish.

PANEL BOARDS.

Where the panel type of board is used, the panels are simply modifications of those required for lower voltages and the usual equipment of instruments for the generators, transformers, feeders, etc., is mounted on the same panels as the controlling devices.

Fig. 1 shows the switchboard supplied to the Louisiana Purchase Exposition in St. Louis in 1904, which was used for the control of three 125-volt exciters; four 2000-kw, 6600-volt, three-phase, 25-cycle generators; two 4000-kw incoming feeders; and 17 outgoing feeders. These panels were provided with the usual equipment of instruments, etc., similar to a hand-operated board, but instead of placing the oil switches or their handles and mechanism on the panels, they were placed at a distance, made electrically-operated and their controllers and indicators located on the switchboard panels.

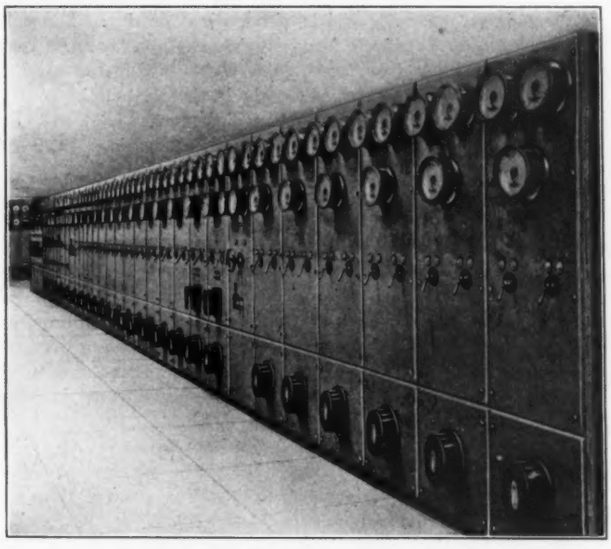


FIG. 1.—SWITCHBOARD USED AT THE LOUISIANA PURCHASE EXPOSITION.

Fig. 2 shows the switchboard recently supplied for the new union station at Washington for the control of four 500-kw, 2300-volt, three-phase generators and nine three-phase and six single-phase feeder circuits. While the rating and voltage of the machines would have readily permitted the use of a switchboard with hand-operated, oil, circuit-breakers, other considerations caused the adoption of electrical operation for the circuit breakers, etc.

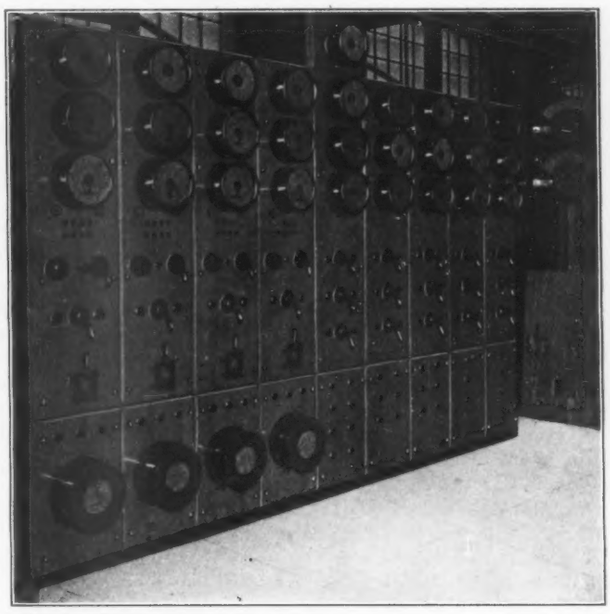


FIG. 2.—SWITCHBOARD FOR UNION STATION AT WASHINGTON, D. C.

As shown by Fig. 1 and Fig. 2, the panel type of switchboard for electrical operation does not differ very materially from that for hand-operation, and these two examples will suffice to show their general design.

Where a more compact arrangement is desired the switchboard panels are replaced by control pedestals or control desks, although often pedestals or desks are used for the generator circuits and panels for the feeder circuits.

PEDESTALS.

This type of control is ordinarily used in plants where the number of generators is small in comparison with the number of feeders. In this case the generators are controlled from pedestals, while the feeders are ordinarily controlled from standard switchboard panels.

One of the earlier types of control stand is illustrated in Fig. 3, which shows the gallery with control stands and generator instrument panels installed in 1901, in the Third Avenue power house of the Brooklyn Heights Railway Company, for the control of six 2700-kw, 6600-volt, three-phase generators, which have lately been recommended for 11,000 volts.

The field rheostat for the generator was operated by means of a large handwheel connected by bevel gear with a face plate mounted underneath the resistors located on a framework in the switchboard gallery. Placing the face plate near the resistor instead of on the pedestal, greatly reduced the length of the rheostat leads and simplified the wiring. The two-pole hand-operated field switch, with extra jaw for the discharge resistance, was mounted on the front of the pedestal shown in Fig. 3. This pedestal consisted essentially of a cast-iron frame with marble slabs arranged as shown to form the front, back and top of the stand, while circular marble slabs on the sides of the stands were used as a support for the handwheel, the reverse-power relay, the knife switches, etc.

As shown in Fig. 3 the station attendant on the switchboard gallery, while standing in front of the pedestals would face the generating room and could readily see over the pedestals and

underneath the panels on which were mounted the instruments in the generator circuit. Each generator control pedestal was provided with the necessary rheostat handwheels, field switch, controllers, indicators, synchronizing receptacles, governor switch, etc., and on the instrument panel directly in front were mounted the various indicating and integrating meters, synchroscope, signal devices, etc.

Each of the feeder panels located on the same gallery as the generator pedestals was arranged to control two three-phase feeders and it was provided with the proper meters, controllers, indicators, relays, etc., for the control of the circuits.

The next step in the pedestal design was to standardize the arrangement of the apparatus and to make the pedestal a cast-iron column with marble slabs on the front and top and removable iron doors on the back. The field rheostat was made sprocket-operated and the field switch was of the knife type. As the generators grew larger the rheostat face plates and field switches were made electrically-operated and the controllers for them were placed on the pedestals with the other apparatus.

With these later pedestals it became the practice to mount the instruments for the generator control on a cast-iron post arranged to stand in front of the pedestal. This post is hollow and the leads to the instruments are brought up inside. Railing sockets are also provided, as the posts are usually located on the edge of the gallery overlooking the engine-room.

In addition to the generator instrument post a station instrument post is supplied. This station instrument post is usually provided with three alternating-current voltmeters, one for each of two sets of bus-bars and one for an incoming machine, one illuminated dial direct-current voltmeter to show the voltage on the exciter bus-bars and one synchroscope. The upper portion of this post is swivelled and provided with a handwheel so that it can readily be turned in any direction in order to make it visible from either end of the gallery or the generator room.

Fig. 4 shows the arrangement of a switchboard gallery for the Union Electric Light & Power Company, of St. Louis, for the

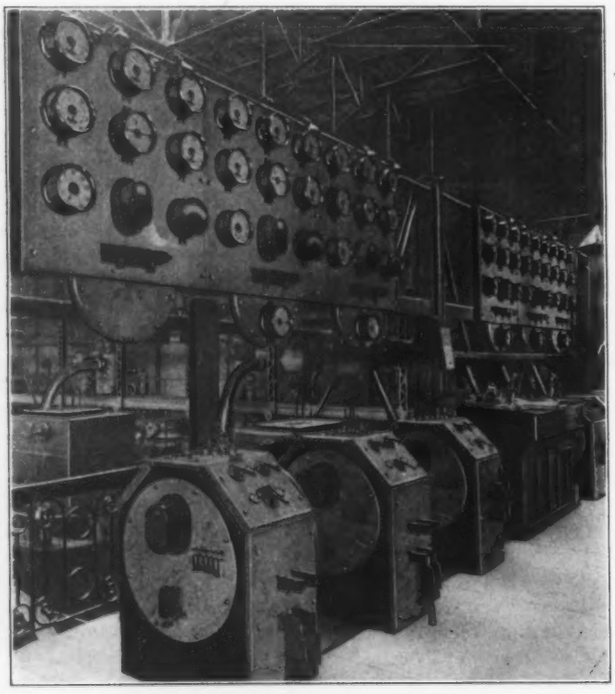


FIG. 3.—EARLY TYPE OF CONTROL STAND.

control of 11 6600-volt, 25-cycle, three-phase generators of various ratings. As may be noted the generator instrument posts are arranged to form the columns of the railing of the gallery. The generator instrument stands are located directly in front of these posts and the feeder panels are back of the stands. The station instrument post is moved in a short distance from the edge of the gallery so as to be more plainly visible from either end.

With this pedestal and post arrangement it is often desirable to use a synchroscope of such size that it may be readily visible from the extreme end of a large power house. For this pur-

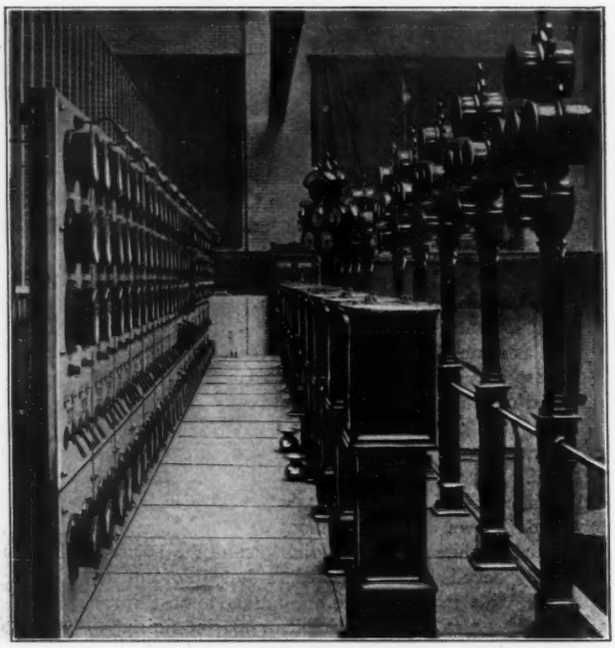


FIG. 4.—SWITCHBOARD GALLERY OF THE UNION ELECTRIC LIGHT & POWER COMPANY.

pose it is customary to furnish a post with a synchroscope which has a 36-in. dial illuminated by two lamps back of the letters "F" and "S," indicating fast and slow. The pointer of the synchroscope is formed of a tubular lamp and the motion of the pointer is readily visible either night or day. The post is provided with a swivelled top so that the synchroscope may be turned in either direction.

One of the latest control pedestals is that shown in Fig. 5, one of six now installed in the distributing station of the Ontario Power Company at Niagara Falls, Ontario. Each of these pedestals takes care of one 7500-kw or 9000-kw, 12,000-volt, 25-cycle, three-phase generator and one bank of three 3000-kw step-up transformers. On this pedestal, in addition to the oil circuit breaker controllers with their indicating lamps, a miniature bus has been placed showing exactly what connections have been made by the circuit breakers. With each of these pedestals is provided an instrument post containing the various meters required in the generator and transformer circuits. On a slab near the bottom of the post are mounted testing jacks to enable the various meters to be calibrated in position.

CONTROL DESK OR BENCH BOARDS.

Where it is desired to reduce the length of the operating board to a minimum it is usual to install a control desk or bench board and to mount on the top of the desk the various controllers for the circuit breakers, electrically-operated field switches, field rheostats, governor motors, etc. Wherever possible, the instruments for the various circuits are mounted in such a position relative to the sections of the control desk as to indicate clearly to the station operator the instruments belonging to particular circuits.

With a control desk the instruments can be mounted either on independent switchboard panels, on panels forming the back of the control desk, or in an instrument frame back of and usually higher than the top of the control desk, or an instrument post.

Where independent panels are used with a control desk the panels usually occupy a greater amount of space than the desk and it is possible for the station operator to become confused in determining what instruments belong to a certain generator or feeder whose controlling devices are on the desk. As a rule, card holders or name plates are placed both on the desk and the panels and the grouping of the instruments is made as far as possible to correspond with the grouping of the controlling devices.

Where the instrument panels form the back of the control desk the instruments are arranged to correspond in location with the controlling devices for the same circuits.

One of the drawbacks of this type of control desk is the fact that the instrument panels which form the back of the desk shut in the view of the operator so that normally it is necessary for the operator to have his back towards the station.

Fig. 6 shows the control desk installed in the Williamsburg generating station of the Brooklyn Heights Railway Company and at present used to control three 7500-kw turbo-generators and two 10,000-kw turbo-generators with provision for future extension up to a total of nine generators. This arrangement of the desk permits the station attendant to face the generator room and readily observe the operation of the machines he intends to control. An independent instrument frame is provided back of and above the control desk and its height is such that the operator looks over the top of the desk and under the bottom of the frame.

The feeder panels for this installation are arranged to form an arc of the circle. By the use of vertical, edgewise instruments a very compact arrangement has been secured. The recording instruments, relays, calibrating switches and such similar apparatus that the station attendant does not need to be continually watching are located on independent panels back of and concentric with the feeder instrument panels.

Where the number of feeders is comparatively small in re-

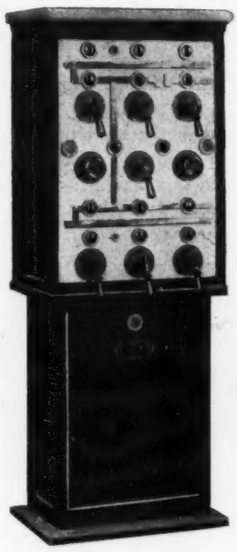


FIG. 5.—PEDESTAL.

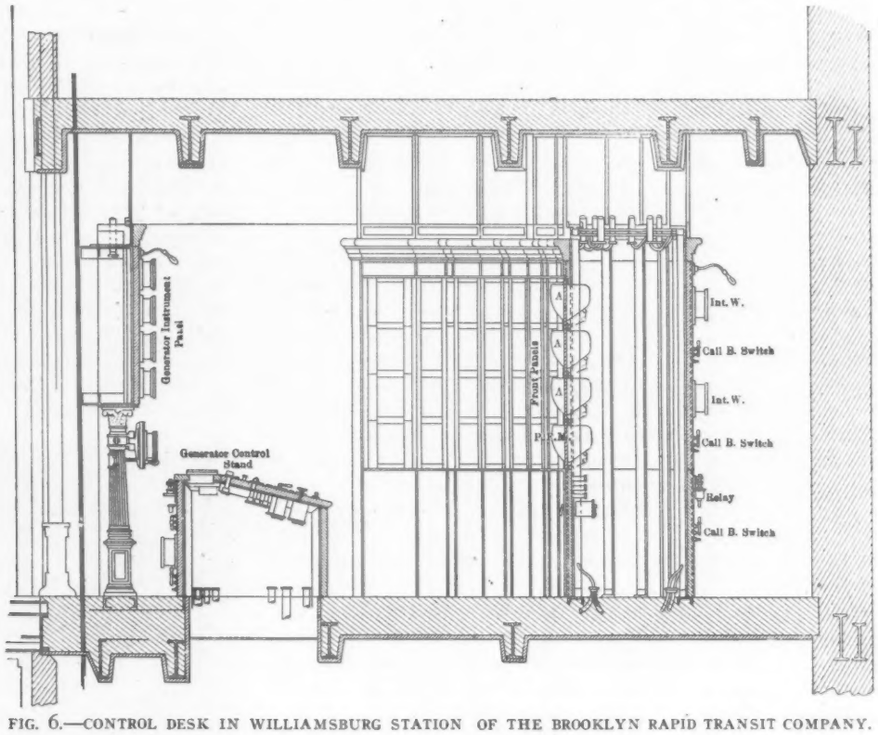


FIG. 6.—CONTROL DESK IN WILLIAMSBURG STATION OF THE BROOKLYN RAPID TRANSIT COMPANY.

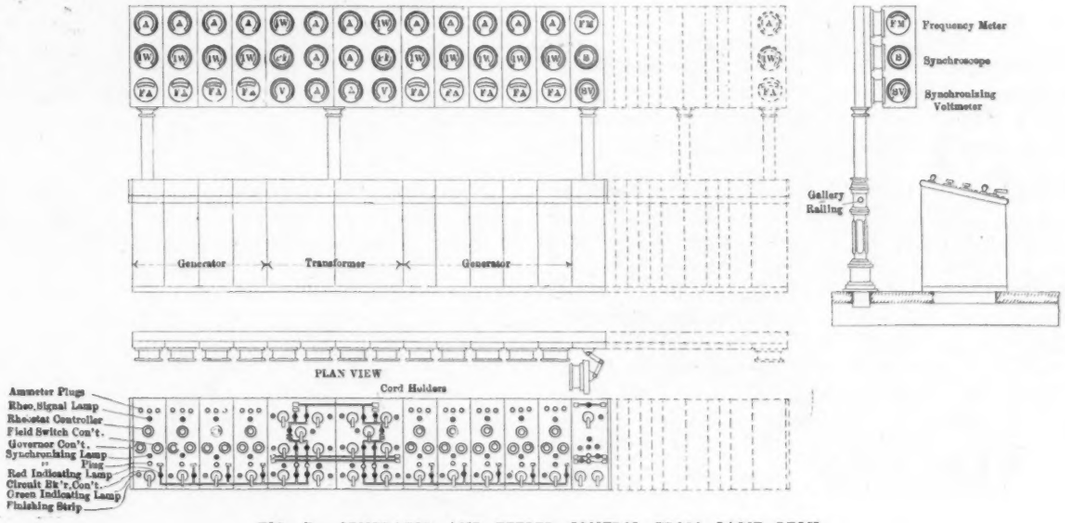


FIG. 7.—GENERATOR AND FEEDER CONTROL FROM SAME DESK.

lation to the number of generators, it is often possible and advisable to control the feeder circuits from the same desk as the generator circuits as shown on Fig. 7. This desk is used for the control of nine 2500-kw, 6600-volt generators, two banks of transformers, each comprising three 4000-kw, 6600 to 66,000-volt units delta connection low-tension and star connection high-tension and two 110,000-volt outgoing feeder circuits. The ultimate installation will comprise 18 generators, four banks of transformers and four transmission lines.

As shown by the miniature bus on the top of the desk the generators will normally be operated in groups of four or five and these groups can be connected to either of two sets of bus-bars. The transformer group will be operated from either of these two sets of bus-bars and the high-tension connections are so made that normally each transformer bank will feed out over its own transmission line, but can be connected to a high-tension bus.

The control desk is intended to be located at the edge of the switchboard gallery and the post for the instrument frame will also form the post for the railing of the gallery. The various sections of the desk are provided with the controllers, meters, etc., necessary for the proper operation of the various generator, transformer, line and tie circuits. On the portion of the instrument frame back of and above this tie panel is located a pivoted panel on which is mounted a frequency meter, synchroscope and synchronizing voltmeter. This desk, like most of those where only a portion of the ultimate plant is to be installed at first, is made on the unit system and new sections can be added without disturbing the symmetry of the arrangement and without interfering with the operation of the plant.

It may be of interest to note that this control desk is to be installed in a plant of approximately 50,000 kilowatts ultimate rating and that there will be three of these plants operating in multiple and distributing energy at 110,000 volts over a large section of country. Owing to the low-head available at two of the plants, 2500-kw units will be installed, while at the third plant 5000-kw units will be used.

Where a very compact arrangement is desired a control desk with vertical, edgewise instruments can be used for the purpose, as shown in Fig. 8, which illustrates the equipment being furnished to the Rio Janeiro Traction, Light & Power Company for the control of six 5000-kva generators and six banks each of three 1700-kw, 6600 to 88,000-volt transformers and four 88,000-volt transmission lines. In this plant an electrically-operated, oil circuit-breaker and a double set of disconnecting switches are provided for the high-tension side of each of the six transformer banks so that they can be connected to either of the two sets of high-tension bus-bars. These two sets of high-tension bus-bars are divided in the middle so that there are practically four sets of bus-bars, which can, however, be tied together through electrically-operated, junction circuit-breakers.

An electrically-operated, oil circuit breaker and a double set of disconnecting switches are provided for each of the four outgoing transmission lines so that the line can be connected to either of two sets of bus-bars. With this arrangement a very flexible combination of generators, transformers and lines may be obtained and it is possible to operate the four transmission lines entirely independent. Marine finished slate is used for the top of this desk and planished steel plates for the ends, front and back. These plates are light, strong and readily removable to obtain access to the interior of the desk. A steel instrument frame is provided and the unit idea has been carried out to allow for future extensions.

A miniature bus system, with red and green lamps to indicate whether the circuit breaker is open or closed, is located on the top of the desk and miniature disconnecting switches are placed in the mimic bus-bars as the double-throw system on the high-tension circuits is obtained by means of disconnecting switches. After closing or opening any of the high-tension disconnecting switches, the station attendant reports the fact to the switchboard operator so that the latter can set the miniature ones to correspond. This scheme furnishes the operator with all necessary information as to the conditions of the high-tension connections which are not apt to be changed from day to day.

The electrical control in the Rio Janeiro plant is extended to the field coil and exciter circuits as well as to the generators, transformers and lines, all of the controllers, etc., being mounted on the top of the desk and the instruments being in the switchboard frame. Vertical, edgewise meters are used throughout with the exception of the synchroscope and power factor meters where a 360-deg. scale was desired.

A complete set of graphic recording ammeters, voltmeters, wattmeters, power-factor meters, frequency meters, as well as polyphase watt-hour meters is provided for each of the four outgoing 88,000-volt lines. In the receiving station of this plant, the control desk for the line and transformer circuits is somewhat similar to that for the generating station with some slight changes.

Small green telephone lamps are placed in the miniature bus system on the desk in place of the miniature disconnecting switches and these lamps are connected in series with standard incandescent lamps and snap switches located in the passageway from which the disconnecting switches are to be operated. The station attendant, after pulling out the disconnecting

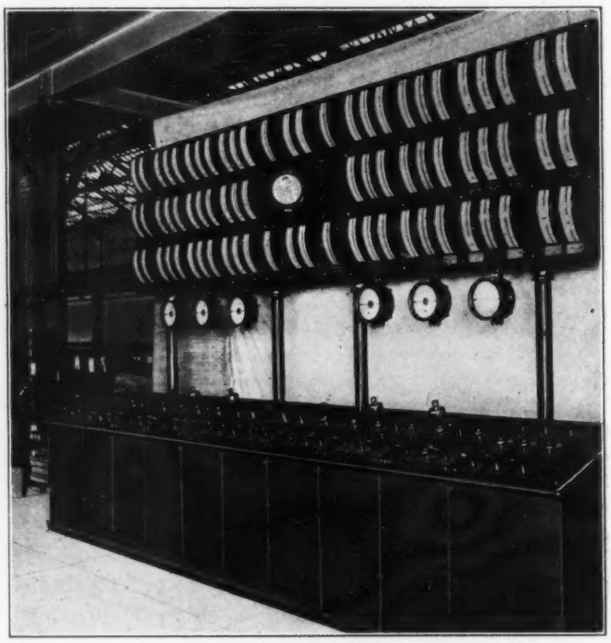


FIG. 8.—CONTROL BOARD FOR RIO JANEIRO TRACTION, LIGHT & POWER COMPANY.

switches, closes the snap switch and in this manner lights the green lamp on the desk and the standard lamp near the switch. In a similar manner, after closing the disconnecting switch, the snap switch is turned to extinguish the light. Failure of the telephone lamps will indicate that disconnecting switches are closed.

As it will be difficult in this receiving station for the attendant to see whether the oil circuit breaker whose disconnecting switches are to be operated is open or closed, red and green lamps are installed opposite each set of disconnecting switches and these lamps are operated by a signal switch on the oil circuit breaker in the same manner as the red and green indicating lamps on the control desk.

While the switchboard equipment of every large station presents special features that have to be embodied in its arrangement to suit local conditions, it is hoped that the examples given, although all taken from the designs of the same manufacturing company, will be of interest and value to engineers connected with the design and operation of stations embodying some of the features mentioned.

Direct-Current Motors: Their Action and Control—IV.

By F. B. Crocker and M. Arendt.

SHUNT MOTOR SPEED CONTROL.

WHILE for many classes of work a practically constant speed is called for, there are also many tools and machines for which it is necessary or desirable to vary the speed. We have many ways by which to obtain this speed variation, and the particular method to employ depends upon the amount of speed variation required, the cost of electric energy and the total cost of the motor and equipment. There are two general conditions of speed control; the first giving adjustable speeds at constant torque (if desired); the second giving adjustable speed with variable torque. The first group depends primarily on variation of the applied armature voltage, and the second depends on change of field flux.

Armature Rheostat Control.

1. The first method which naturally suggests itself is the variation of armature voltage by means of a resistance in series with it. The current-carrying capacity of this regulating resistance must naturally be greater than that of the ordinary starting box, since it may be in circuit for long periods. The accepted design is such that it will not heat up to more than 100 deg. C. on continuous service with rated load current. The large current capacity is obtained by making up the resistance units in plate form, since in this manner large radiating surface is obtained. Consideration of equation IX

$$V = c.\ e.\ m.\ f. + I_a R_a + D_b + I_a R_x$$

shows that if the ohmic drop is increased, the c. e. m. f. must naturally decrease to maintain reaction equal to action, and, as already shown, when the c. e. m. f. is reduced, the speed diminishes in the same ratio, hence the armature rheostatic control of a motor is a method of speed regulation which can only decrease the speed of the machine.

Speed-Control Rheostat.

For the sake of simplicity in the following problems, the stray power losses will be assumed to be the same at no-load and full-load—in fact, as already shown, the change affects the efficiency by only a very small amount. Assume that it is required to design a resistance box to be employed as a speed controller for the 10-hp motor, and this control is to give a speed variation in four steps from one-quarter to rated speed, at rated torque and for continuous service at any of the four speeds. Since rated torque is to be developed, we should consider the motor armature as operating "hot," hence its resistance R_a is .28 ohms and the speeds desired are 206, 412, 619 and 825 r. p. m., respectively, the last being the rated speed. Tabulating the conditions of torques and speed desired and recollecting that $I_a R_x = V - (c.\ e.\ m.\ f. + I_a R_a + D_b)$ we obtain the following results:

	A	B	N		
Speed Desired r.p.m.	c.e.m.f. = $\frac{\text{r.p.m.}_x}{\text{r.p.m.}_r} \times 218.2$ V.	Armature Drop $I_a R_a$ $37 \times .28$ Volts	Brush Drop D_b Volts	External Drop = 230 − (A+B+N) $I_a R_x$ Volts	External Resist. R_x Ohms
¼ = 206	54.55	10.4	1.41	163.6	4.4
½ = 412	109.10	10.4	1.41	109.1	2.9
¾ = 619	163.60	10.4	1.41	55.6	1.5
rated = 825	218.20	10.4	1.41	0.0	0.

Knowing the value in ohms of the various resistances required in the controller, it is still necessary to determine the size of box that will allow the needed emitting surface to be obtained. The temperature rise usually permitted in speed regulating rheostats is 100 deg. C., and with the temperature limit known, the surface of the resistance units can be calculated, because the heat energy produced must equal that emitted; that is

$$.24\, I_a^2 R_x = hAt \qquad (10)$$

In which I_a is the rated current, A the surface of the resistance metal in sq. cm., R_x the total resistance of the rheostat, h the emissivity of the resistance metal (*i. e.*, gram-calories emitted per sq. cm. per degree C.), and t the difference between room and rheostat temperature in degrees C. The controller resistance R_x as calculated is 4.4 ohms, the current I is 37 amperes, the emissivity h of nickelin (the resistance metal employed) is .000506, and the difference in temperature t is 100 deg. C. Substituting these values in equation 10 we have $A = \frac{.24 \times 37^2 \times 4.4}{.000506 \times 100}$ or 28,600 sq. cm. That is, the nickelin wire employed must have an emitting surface of 28,600 sq. cm. so as not to increase in temperature more than 100 deg. C. at rated load. Knowing the resistance required and the radiating surface, the length of the resistance wire can readily be calculated if the cross-section be decided upon. Assuming a circular wire, the following formulae of resistance and length apply: Surface area $= 2\pi Lr$ and $R_r = \frac{\rho l}{\pi r^2}$; where area $= 28{,}600$ sq. cm., l the length in cm.; r the radius in cm., R_r the total resistance (4.4 ohms) and ρ the specific resistance of nickelin (*i. e.*, .00005 ohms per cm. cube). Substituting these values in the above equations we have:

$28{,}600 = 2\pi lr$ or $l = \frac{28600}{2\pi r}$; and $4.4 = .00005\, \frac{l}{\pi r^2}$ or $l = \frac{4.4 \pi r^2}{.00005}$. Equating these values of l and solving for r, we obtain $r = .253$ cm.; from which $l = 18{,}000$ cm. That is, the nickelin wire required would have a diameter of .506 cm. (No. 4 B. & S.) and a length of 180 meters.

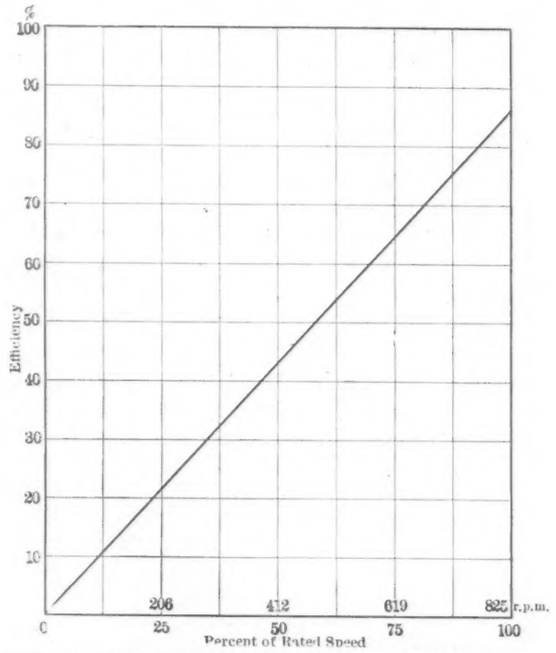


FIG. 1.—EFFICIENCY CURVE OF 10-HP MOTOR, RHEOSTAT CONTROL.

A simple method of constructing this box is to employ resistance units in the form of helices. A helix 4 cm. diameter requires $\pi 4$ or 12.5 cm. of wire per turn, or 1 meter of wire would make eight turns. These turns should be about .5 cm. apart, which is equal to the diameter of the wire, so that eight turns require 8 cm. height, and each section of resistance (1.47 ohms) would be 60 meters long, forming 60×8 or 480 turns. Hence, each section if made up in one helix would be 480 cm. high. In order that a section should not be too long, let us divide it into 12 units, each 40 cm. high. For the complete box 36 units are required, each 40 cm. high and 4 cm. in diameter. These coils should be placed so as to have 1 cm. space between them for ventilation, and to avoid short-circuiting, hence the box would be 6×5 or 30 cm. wide and of the same thickness. The dimensions of the finished box would accordingly be $40 \times 30 \times 30$ cm., containing 160 meters of nickelin resistance wire No. 4 gauge.

Discussion of Speed Control by Armature Rheostat.

The efficiency, of such a combination for obtaining motor speed control at the various r. p. m. selected, is determined as follows: The stray power losses affect the efficiency at the

various speeds so slightly that for this calculation we assume them as constant at their value for rated load and speed; correction can, however, be made, as shown later.

A motor operating at a constant torque will have an output directly proportional to its r. p. m.; hence, we have the following tabulated results:

Efficiency of Speed Control by Armature Rheostat, at Rated Torque.

Constant Input		Total Watts			R. P. M.	Output Watts	Efficiency Per Cent
230	× 37	= 230	× 1	= 8740	825	7550	86.5
"	"	"	"	" 8740	619	5662	64.8
"	"	"	"	" 8740	412	3775	43.2
"	"	"	"	" 8740	206	1887.5	21.6

If we plot these efficiency values as ordinates and the speeds as abscissæ, we have a straight line, as shown in Fig. 1. Hence it is sufficient to calculate one value and draw a line through this point and the origin. A study of this method of speed control will bring out the following objections:

(*a*) *Bulk of Rheostat.* This may not be very objectionable if only a few motors are so controlled, but for a number, the extra space becomes a factor, and in many cases it is difficult to find sufficient room near the motor.

(*b*) *Inefficiency of the System.* The same amount of power is supplied at all speeds, but at low speeds only a small part of it is converted into useful work, the balance being wasted as heat. Thus, with the 10-hp motor the useful work at one-quarter speed is only 21.6 per cent of the total input.

(*c*) *Poor Speed Regulation with Varying Loads.* Since the impressed voltage at the armature terminals is equal to the line voltage minus the resistance drop in the regulator ($V_t = V - I_a R_x$), any change in the current drawn by the motor produces a change in the terminal voltage, the c. e. m. f., and, therefore, the speed. The changes in speed likely to occur with load changes may be very great, and are best brought out by a specific example. Consider the 10-hp motor and controller box just designed for it, and assume that the motor is driving a lathe at rated torque (37 amperes) and at one-half speed. That is, the motor is running at 412 r. p. m. and a full cut is being made; suddenly, however, the machinist so changes the depth of cut, that the torque falls to one-quarter of the rated value—that is $I_a = 9.25$ amperes—and the increase in speed will be very considerable, as follows:

The total *IR* drop in the armature circuit is at this reduced current equal to $9.25 \times .28 + 9.25 \times 2.9 + 1 = 30.4$, or the c. e. m. f. $= 230 - 30.4 = 199.6$ volts. Hence, r. p. m. $= \frac{199.6}{218.2} \times 825.0 = 755$, or the speed rises suddenly from 412 to 755 r. p. m.

Convenient Tests for Central Station Operators.

By W. M. Hollis.

INSULATION RESISTANCE.

In power houses where there is a full complement of testing apparatus, various electrical measurements are ordinarily made without much trouble. Where very accurate measurements are required, sensitive apparatus is necessary, and usually a great deal of time and not a little calculation.

The insulation resistance of the various dynamos and motors should be measured from time to time, and in such cases only rough values are necessary in order to determine whether the insulation is greater or less than the predetermined value. The method outlined is also adapted for ascertaining the insulation resistance of wires. Suppose, for example, that the insulation resistance of a dynamo between the armature core and the armature wires is required: this measurement may be taken with an ordinary voltmeter, as shown in Fig. 1. Having a constant potential, 110-volt, direct-current service at hand, two readings are necessary. First, the voltage across the line; and then the voltage with the voltmeter in series with the resistance to be measured, both being connected across the line. In the illustration, the voltmeter is shown connected for obtaining the insulation resistance between the armature wires and the armature core. V equals the voltage across the line, and V' the voltmeter reading when the instrument is in series with the insulation to be measured, R_v equals the resistance of the voltmeter, and R the insulation resistance. I' equals the current in the voltmeter when the latter is connected in series with the insulation. In the latter case $I' = V \div (R_v + R) = V' \div R_v$ and $V \times R_v = V'(R_v + R)$ and $R = (\frac{V}{V'} - 1) \times R_v$.

In cases where many resistances have to be calculated, a table may be compiled, or, better still, a curve plotted from a number of values of the resistances calculated from a number of voltmeter readings. For instance, with the line voltage constant, substitute various values for V', as 10, 20, 30, etc., to the full scale voltmeter readings in the equation $R = (\frac{V}{V'} - 1) \times R_v$, and tabulate the results. For approximate values and for all ordinary uses, with a device of this character the insulation resistance for values of V' between the tabular values may be estimated. The values of V' and corresponding values of R may be arranged in parallel columns, the voltage, of course, always being at the value first used and kept constant at the original value of V when readings are taken.

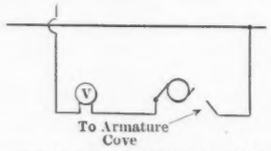


FIG. 1.—INSULATION RESISTANCE MEASUREMENT.

WALL TESTING APPARATUS.

In many electrical repair shops or places where new apparatus is tested, a scheme similar to that shown in Fig. 2 may be used for a variety of purposes. The connections shown are arranged for a circuit having a potential of 2000 volts, but, of course, may be used for a considerable range of voltages if due regard is given to proper wiring and insulation, and extra precautions are taken where high voltages are used.

In the sketch 20 incandescent lamps are shown, arranged in series upon a suitable base, with taps taken out at every second lamp. A switch is arranged between the lamps and the line. A dial contact device or rotary switch having ten contact points and a lead from every second lamp is connected to one of these contacts. Tapped from one of the main wires just beyond the series of lamps, and beyond the switch, is a lead connected to the second switch, as shown. Another lead is connected to the pivot of the dial switch at one end, and to the second switch at the other end. A pair of heavily insulated cables of such length as to reach conveniently to all parts of a suitable testing bench have at their ends a number of insulated handles, the leads passing through the handles and terminating in pointed metal rods, extended some distance beyond the handles. For convenience, ordinary insulated flexible cables covered with rubber tubing may be used for the flexible leads.

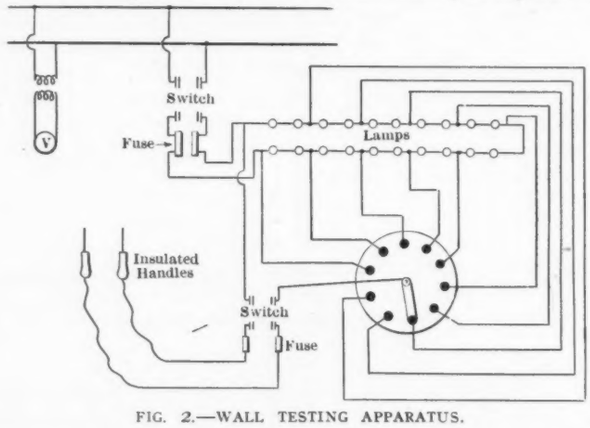


FIG. 2.—WALL TESTING APPARATUS.

When the dial switch is rotated, the voltage at the terminal

points is varied in steps of 200 volts. Proper precautions must, of course, be taken to have the various leads and lines well insulated from the ground. The lamps and dial switch should be near together to save the complication in wiring, and both should be near the testing bench upon which the devices to be tested are placed. Those familiar with handling high voltages will understand the necessity for proper precautions, both in insulating the device and in using the same.

LOCATING GROUNDS IN CABLES.

A convenient method of locating the point on a cable where a ground exists, necessitating the use of a milli-voltmeter, is illustrated herewith, and the method outlined may be used where the ground is a substantial one and there are other ungrounded cables adjacent to the faulty one. The cables should be connected together, as shown at *c*, near the testing point and at *d*, beyond the ground, *B* representing the grounded cable and *A* another cable near the same. A known variable resistance, *R*, of such value as to give a convenient deflection on the milli-voltmeter, is placed successively in circuit in cables *A* and *B* and readings taken. At the point *d* the cables are connected to constant potential mains, one side of which is grounded through a lamp or other suitable device. The distance of the fault *X* from *d* or *c* may then be calculated approximately, as follows:

Measuring from *d*, let *l* represent the length of the cable in feet between the points *d* and *c*, and let *n* represent the length of the cable in feet between the point *c* and the fault, and let *m* represent the length of the cable in feet between the point *d* and the fault. The resistance R_a is equal to the resistance of the cable *A* to the fault, or $l+n$, and the resistance R_b is equal to the resistance of the cable *B* from *d* to the fault, or *m*. Hence, $R_b \div R_a = m \div (l+n)$ and equals the voltmeter reading in *A* divided by the voltmeter reading in *B*.

Calling the voltmeter readings in cable *A* and cable *B*, *G* and *G'*, respectively, $m \div (l+n) = G \div G'$. Now $l : l+m+n :: G : G+G'$ and since $l+m+n = 2l$, $m : 2l :: G : G+G'$; whence $m = (2l \times G) \div (G+G')$ or $m = 2l\left(\frac{G}{G+G'}\right)$

To obtain the insulation resistance with the above apparatus, with a weak spot in the cable *B* as indicated, place the known resistance *R* in circuit with the cable *B* and connect to the 110-volt mains as before, attaching the milli-voltmeter to *R*. If *V* is the reading of the voltmeter, and *I* the current in the cable *B*, and *R'* the resistance used with the voltmeter, and R_b the resistance of the cable to the fault including *R*, and R_x the insulation resistance at *X*, *E* being the applied voltage, then $I = E \div R = E \div (R_b + R_x)$. R_b being negligible compared to R_x the equation may be written: $I = E \div R_x$. Hence $R_x = E \div I$, and $I = V \div R'$. First get the highest resistance measurable on the apparatus; assume *R'* equal to 500 ohms, and 0.005 the readable deflection. Then $I = 0.005 \div 500 =$ 0.00001 ampere. Inserting this value in the equation $R_x = E \div I$, $R_x = 110 \div 0.00001 = 11{,}000{,}000$. Hence, any resistance less than 11 megohms will give a readable deflection. For a full

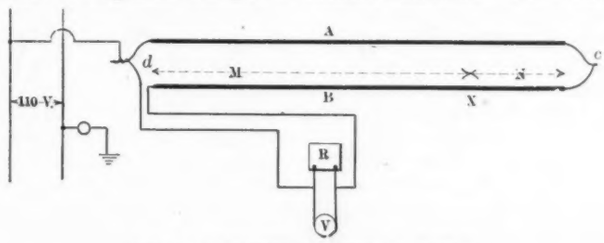


FIG. 3.—LOCATING GROUNDS IN CABLES.

scale deflection (1 ampere), $I = V \div R' = 1 \div 500 = 0.002$ ampere, and $R_x = E \div I = 110 \div 0.002 = 55{,}000$ ohms. Now, $R_x = E \div (V \div R) = (ER) \div V$. Hence, $R_x = (R \div V) \times E$, and since *E* is a constant, in this case 110 volts, R_x varies with $R \div V$.

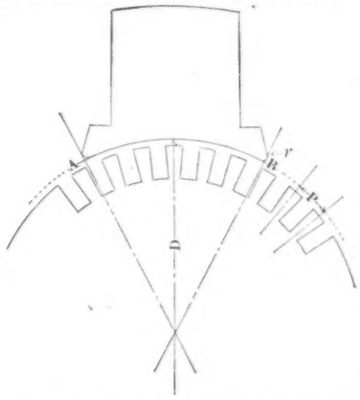
By varying the resistance used with the milli-voltmeter, or using a larger milli-voltmeter, other ranges of resistance can be measured. Hence, by substituting the proper values for *R* and *V*, the apparatus may be arranged for measuring the insulation resistances required. Ordinarily extreme accuracy is not desired, the measurement being made merely to ascertain whether the insulation is sound.

Noisy Operation of Dynamos.

BY NATHANIEL R. CRAIGHILL.

One of the most troublesome of the minor difficulties encountered in the design of direct-current motors and generators where laminated magnet cores are used is that due to noisy running. Many methods have been tried to eliminate this defect, such as chamfering the poles, toothing the tips, or varying the air-gap from center of pole to tip, but all of these expedients are of more or less doubtful utility, and even at best are only trial methods the success of which can not be predicted.

As a matter of fact, however, it is possible by means of calculations based upon the dimensions of a machine to predict



CUSTOMARY SHAPE OF LAMINATED POLE TIPS.

with a great degree of certainty whether or not it will be noisy. In all cases where noiseless operation is required, it is necessary as a first condition to keep the pole face density below a certain amount, which for medium and large-sized machines should not be over 50,000 lines per square inch, and for small ones considerably less. When this density is exceeded, it is practically impossible to prevent noise.

It is well known that with few slots per pole there is much more likelihood of noisy running than is the case with relatively many, and where they number 15 or more there is usually no trouble. Large air-gaps are also conducive to quiet operation, but, unfortunately, large air-gaps require excessive field circuit copper, and, therefore, are not to be considered.

It can be shown by experiment that the pitch of the note given out by a machine depends upon the number of teeth in the armature and the speed of the machine, and that the possibility of having noisy running at all depends upon certain relations between the slot pitch and the length of the pole arc. It is not difficult to determine the pitch of the note that a machine emits by the help of a tuning fork.

For the convenience of those who wish to experiment for themselves, the following table showing the number of vibrations per second corresponding to various notes is given:

C_1, 264; D_1, 297; E_1, 330; F_1, 352; G_1, 396; A_1, 440; B_1, 495; C_2, 528; D_2, 594; E_2, 660; F_2, 704; G_2, 792; A_2, 880; B_2, 990.

As an example of the application of the foregoing table, a machine having 47 slots at a speed of 1125 r. p. m. (18.75 r. p. s.) emitted a note corresponding almost exactly to A_1 (880 vibrations per second). Now, $880 \div 18.75 = 47$. Similarly another machine having 40 slots and running at 660 r. p. m. (11 r. p. s.) gave out the note of A_1 (440 vibrations per second) $440 \div 11 = 40$.

In each case, the noise was entirely eliminated by trimming off the pole tips slightly. In any case, where a machine runs noisily, it can be quieted by trimming the pole tips a trifle; still further trimming will result in alternate noise and quiet. The same result can be obtained by changing the number of slots and leaving the length of the polar arc the same. In other

words, there are certain relations between pole arc and slot pitch which produce noisy running and certain other ones which do not. It seems, therefore, that the more nearly the ratio between pole arc and slot pitch lies midway between two whole numbers, the less tendency there will be for a machine to be noisy, which conclusion appears to be well borne out by experiment. Expressed in the shape of a formula this would be pole-arc ÷ slot-pitch = an integer + ½, for quiet operation, and pole-arc ÷ slot-pitch = an integer, for noisy operation.

When the pole tips are rounded, as shown in the accompanying illustration, which is the customary shape for laminated pole tips, the effective length of the pole arc must be used in the formulas. Experiment shows that if the length of the pole arc is taken along the air-gap circumference $(A - B)$ and the radius of the pole tip is r, then the effective pole arc is $AB - 0.81r$. If D is the air-gap diameter, and n the number of slots, the slot pitch P at the air-gap circumference will be $P = \pi D \div n$.

The formula, then, for practical application will be $(AB - 0.81r) \div P = K + ½$, for quiet running, and $(AB - 0.81r) \div P = K$, for noisy running, where K is an integer.

Numerous experiments have shown that when the quantity $(AB - 0.81r) \div P$ is equal to an integar plus a value ranging from $-.10$ to $+20$ the machine is noisy, while when the quantity is equal to an integer plus a value ranging from $+30$ to $+60$ the machine runs quietly.

The Operation of a Small Electric Plant.

By W. H. Wakeman.

MOTORS AND LAMPS.

There are many manufacturing plants in which a portion of the energy required is transmitted by belts and shafting; but for convenience of operation, motors are used to drive some of the machines, and the engineer is expected to take care of the whole outfit, keep it in first-class order and get the best possible results from its operation. If the steam plant has been in use for a long time it may consist of a low-speed engine to drive the shafting, while a modern high-speed engine drives a direct-connected dynamo or generator that supplies the necessary electricity.

Other plants have a partial combination of the above-mentioned units, the engine running at a medium speed of say, 100 r. p. m., transmitting a portion of the energy by belting, and driving in addition a generator which supplies electric energy to the motors.

The commutator and brushes on a motor require the same care and attention as those on a dynamo in order to give good results, although there seems to be a general idea among engineers that a motor requires much more scientific knowledge and a practical application of it. One great difference between the practical operation of a dynamo and a motor is that as a general rule, the former is located in the engine room where it is under the immediate care of the engineer at all times, but the motors are in many plants located where they can drive various lines of shafting, or separate machines most conveniently. In fact this is important, as the energy can be easily transmitted to the motors even at the most distant part of the plant without excessive loss, and the several motors are then near the machines they operate. The natural consequence of this arrangement is that the motors are started by the person nearest to them at the time, and they may be left running until the circuit is opened at the main switchboard in the engine room.

Whenever one person starts a machine in ordinary service and another must keep it in repair, the machine usually needs more repairs and renewal of parts than if one person had entire charge of it, and the reason for this condition of affairs is not difficult to find, because the person starting and stopping the motor has no further interest in the matter, hence these operations are not carefully performed.

A motor ought always to be started slowly, and as it gains speed more resistance can be switched out of circuit until full speed is attained. The motor is then ready for its maximum load.

Fig. 1 illustrates a starting box frequently used for starting motors. The lever ought to be brought over until the pawl holds in the first notch. If the machinery is in good order this will start the motor and run it at low speed. Moving the lever to the next notch cuts out more resistance, but the lever should not be moved further until the motor has attained the speed due to the current thus permitted to pass, and this process should be continued until the highest speed required is secured. The average mill or shop hand will throw the lever over until the pawl reaches the third or fourth notch, then after waiting a few seconds will move it over as far as it will go. The ammeter indicates just what transpires under such conditions, as the pointer will jump far above its normal position, thus showing that much more current is demanded where proper care is not exercised in starting the machinery.

When a motor is to be stopped, the switch near it ought to be opened, then as soon as the magnet which holds the pawl in place loses its attractive force, the starting lever flies back automatically under the action of a spring on to the rubber buffers, thus operating as another switch thrown out, provided every part is in good order, but, unfortunately, this is not always the case as the bearing where this lever is pivoted may be dry and the resulting friction prevents it from operating easily in such a case. The sliding shoe, which comes in contact with the stationary bars, may be actuated by a spring that is too stiff, and it is possible for this to prevent free action of the lever, consequently it will stay just where it was when the motor was running. This does no special harm so long as the circuit is open, but the person who starts the motor may close the switch before he notices the lever, consequently the armature of the motor is subjected to a rush of current at starting 20 or more times the normal number of amperes.

Somewhere in the line there is, or ought to be, a fuse and a circuit breaker, in order to insure the opening of the circuit before damage is done. The circuit breaker will probably open first, as it acts quicker than a fuse, provided it is set to act at the limit of the latter. One advantage of a circuit-breaker is that it can be reset as soon as the defect which caused it to go out is removed. It does not take much longer to put in a fuse, provided there is one at hand; but under average conditions it will require several minutes to find one, and there is always some danger attending the insertion of fuses.

If fuses blow out frequently under unreasonable conditions, there is a great temptation on the part of the operator to insert a piece of copper wire that will carry the load; but this is not good practice, because it may carry the load too well and cause damage somewhere else. In case of frequent failures of a fuse it may be well temporarily to insert a larger fuse, because that will still place a limit on the load that can be carried, while a piece of wire practically removes this limit or places it too high to be safe. Care should be exercised to remove the cause of the overload if this is the cause of the blowing of the fuse, or if the fuse is too small, to ascertain whether a larger fuse is permissible in connection with the size of wire used.

Link fuses are stamped with the capacity of each in amperes, and a comparison of several makes shows that the sizes vary greatly for a given capacity, or fuses of the same size have widely varying capacities. This difference is due to the fact that they are composed of different combinations of metals so that one may consist largely of metal that melts at a low temperature, while a smaller one contains an alloy that requires much more heat to melt it.

Fig. 2 illustrates this point as it shows two fuses made by different manufacturers, the comparative sizes of which are accurately presented. One is rated at 150 amperes, and the other is rated at 200 amperes, therefore one will carry 33 per cent more current than the other. Several of each kind of fuse in use in a plant should always be kept ready for use. If a fuse blows it is exasperating to be obliged to wait 10 or 15

minutes for the engineer to find the right one to replace it, and after it is found he may have to file out the tips so that they will go into place. It is much better to have this done in advance.

Fig. 3 illustrates the wiring on a compound-wound direct-current motor, and after these wires are properly located it is necessary that they be kept in place. This does not necessarily mean that they are liable to become misplaced in regular service, but it may be necessary to take them down to clean or repair the motor, hence each one should be marked with a sharp prick punch in order that mistakes in replacing them may be avoided. To illustrate this point, a certain engineer removed the wires from a motor without marking them as above suggested, as he assumed that he knew enough about the matter to put them back properly. After replacing them he closed the circuit and the ammeter immediately indicated 400 amperes, although the motor only required about 75 amperes.

If the wires are purposely misplaced by some mischievous person to test the ability of the engineer to correct such evils,

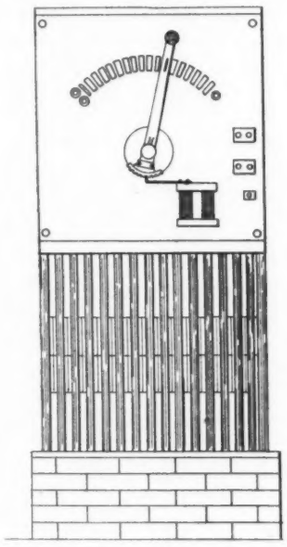


FIG. 1.—MOTOR STARTER.

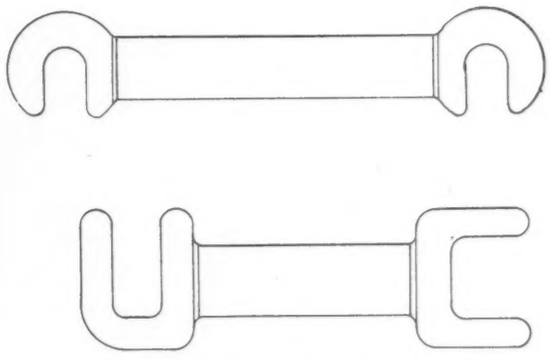


FIG. 2.—LINK FUSES.

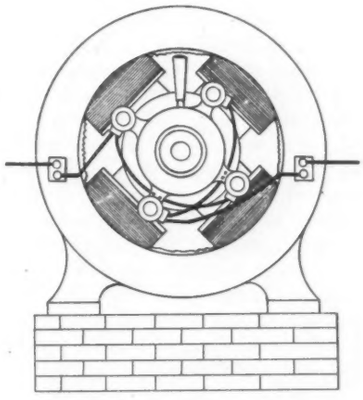


FIG. 3.—COMPOUND-WOUND MOTOR.

the marking process is an excellent way to avoid trouble and annoyance. While such things are not naturally expected, they have happened, and it is a good idea to be prepared for them, especially when it can be done so easily.

Where motors and lamps are on the same circuits, the circuits require more careful watching than where lamps only are used. Wherever it is practicable it is a good idea to start the motors first, as every engineer who takes pride in his plant and the results secured from it, wishes to keep the voltage at the lamps as steady as possible. If the motors are running steadily the lights may be extinguished without causing disturbance of the service, provided the complete line is properly divided into separate circuits, each with its individual switch. On the contrary, if the lamps are placed in circuit first, the light may flicker when the motors are started, and this is always to be avoided if possible. For the same reason the lights should be extinguished first, then the motors can be stopped without causing sudden changes that are apparent to everybody in the building. If for any reason the motors must be stopped first, the lever provided for each, as shown in Fig. 1, can be slowly moved backward one notch at a time until the motor is running slowly, then the switch can be pulled out without affecting the voltage badly.

When considering the operation and care of incandescent lighting circuits, there are three main points that should be remembered:

1. A complete line must be maintained from the commutator to the positive bus-bar, and from the negative bus-bar back to the commutator.

2. Each separate circuit must be kept intact at all points from the switchboard over the positive wire to the most remote lamp, then over the negative wire back to the switchboard.

3. The copper wires composing these lines must be kept free from connection with each other and from grounds.

The first deals with larger parts and more compact service, yet when the terminals of a small cable are firmly clamped to other metal parts perfect contacts are not always secured, because the metal surfaces must be free from foreign matter that is not a conductor of electricity, and if they touch at a few points only the imperfect contact, which cannot always be readily detected, may cause the temperature to rise high enough to melt solder.

With reference to the second point, breaks occur that seem to be unnecessary, and some of them are concealed by the insulation provided for the protection of the wires, or by changes in the wood work, or other unforeseen conditions. Vibration of buildings causes chafing and wear that weaken wires where they are uncovered until they break more readily than when new. A rosette is fastened to the ceiling and a binding screw on each side of it clamps the wire, but if one of them becomes loosened, or is taken out, no electricity can pass until the defect is made good. Rosettes contain places for two small fuses that are held in place by screws, but sometimes one of these fuses is broken by being wound around the screws and pulled apart as the last screw is tightened, although it is not discovered until the lamp fails to light and a careful search is made for the defect.

A socket which is extensively used for incandescent lamps is illustrated in Fig. 4, and it does not require a very close examination to show that there are several places where contacts are made when the appliance is new and in good order, but after the key has been turned an indefinite number of times these small parts become worn, bent or broken until the contacts are imperfect and soon the parts are separated, causing a break in the circuit. It is best to throw away these sockets and put in new ones.

Sometimes a lamp will fail to burn because contact between the base and the socket is imperfect, but the same lamp may burn perfectly when put into another socket, hence this change should be tried before the lamp is discarded, provided the filament is not broken.

Sometimes the filament in a lamp is drawn to one side until it touches the glass and breaks it, and its successors soon share the same fate. This action denotes electric attraction due to a swiftly moving belt, or something else of a magnetic nature nearby, which cause should be removed or guarded against.

Fig. 5 illustrates a receptacle for an incandescent lamp that is designed to be fastened directly to the ceiling or walls of a room. It is a very simple device, but if the lamp base is too large the lamp will not touch at the bottom, therefore, only one connection is made and no light results. If the lamp base is too small, a thin strip of brass may be forced in between the porcelain and the circular fitting, thus pressing it inward and causing the threads to hold.

In many places lamps if not protected are easily broken, but the wire guard shown in Fig. 6 prevents these accidents.

When lamp cord becomes badly worn, especially where it is frequently looped up to raise the lamp, there is danger of direct contact of the two wires, and where a socket is torn off by accident, leaving the ends of the wires exposed, the latter may be easily brought together and cause trouble. When putting on a new socket one strand of the lamp cord may become

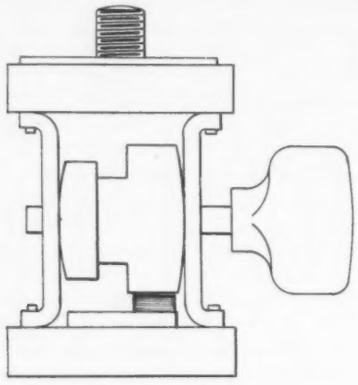


FIG. 4.—LAMP SOCKET.

separated from the others, and if this touches the other wire it may be sufficient to cause a short circuit. If an insulated wire is allowed to rest on a gas pipe, vibration may wear away the insulation until the wire touches the iron pipe, thus causing a ground.

Combination gas and electric fixtures are a source of trouble and annoyance unless the internal wires are carefully insulated and there are no sharp edges left on the brass tubing to cut through the insulation and thus make a short-circuit. In some cases this work is done very carelessly, hence when the circuit is closed on a five or six-lamp chandelier and there is a flash near the ceiling it is evident that the fuse has blown. It is an easy matter to replace the fuse, but it is evidently not a good idea to close the circuit again and repeat the experience without removing the cause.

The rules for electric wiring allow the omission of fuses near the ceiling, as fuse plugs in the junction boxes are deemed sufficient, and so far as safety is concerned they are, but there are other points to be taken into consideration. Several chandeliers or groups of lamps are fed through each plug, therefore without the separate fuses a short-circuit on one chandelier

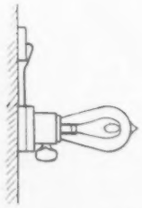


FIG. 5.—RECEPTACLE FOR WALL LAMP.

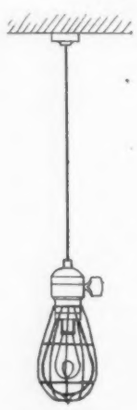


FIG. 6.—LAMP GUARD.

extinguishes all of the lights, making it difficult to tell where the cause of trouble is located. Furthermore, no light can be secured from any of them until the defect is found and a remedy applied. Such an accident may happen when light is badly needed and at a very inconvenient time to repair the break. For these reasons separate fuses near the ceiling are preferred, as a short-circuit disables but one chandelier. When a direct-current arc lamp is to be installed on a direct-current circuit care must be taken to connect the wires to the proper binding posts in order that current may travel through the mechanism in the right direction. There may be no way to determine this point except by experiment. Connect the wires to the binding posts, close the circuit for about one minute, then open it again and watch the carbons. If the upper one remains red longer than the lower, current was passing in the right direction, showing that the connections are properly made. If the lower one remains red after the upper has turned dark, the connections must be reversed.

When trimming arc lamps set the lower one in place, then put in the other. The latter should stand central with the former. Revolve the upper one a number of times and see if it remains in line while turning. If it wabbles it ought to be adjusted until it remains in line. These precautions should be taken to prevent the upper carbon from slipping by the lower one.

If an arc lamp flickers excessively when placed in circuit, the plunger in the dash-pot is probably too loose. If the plunger is too tight, it will stay in one place and fail to feed properly. When the upper carbon remains down on the lower it usually indicates that the small clutch which is intended to grip the carbon is not in good order. All of the parts should be kept as free from dust and dirt as possible.

The engineer in charge of an electric plant that is used in a mill, shop, or factory should profit by the experience of others in similar situations, and thus prepare for emergencies before they arise, not only learning to avoid accidents, but studying problems concerning what may happen and thus know what to do when trouble does come.

Fittings for Superheated Steam.

While there is some question as to the exact economy effected by the use of superheated steam, due to lack of accurate data as to the extra amount of coal required to obtain a given amount of superheat, there is little doubt that superheating in moderate amounts, say, up to 200 deg., pays in connection with steam turbines, and it is quite practicable to work to this degree of superheat by the use of suitable materials and properly designed apparatus. On this point, Mr. A. H. Kruesi gave some valuable information at the last annual meeting of the Association of Edison Illuminating Companies.

Experience with turbines especially designed for such service indicates that they require no additional attention or maintenance due to the use of highly superheated steam. Superheaters themselves have been a source of considerable trouble in many plants largely on account of leaky joints occasioned by variation of temperature through wide limits. It is an essential requirement in a successful superheater that it shall be readily drained of water. It is desirable also that the flow of steam shall be continuously downward through it and from it; that is, that it shall neither contain water pockets within its structure nor constitute a water pocket as a whole.

The feature of the plant which requires most attention in design on account of superheat is the steam piping. Experience in plants at Schenectady and Lynn and elsewhere with superheat up to 300 deg. F. indicates that the piping must be radically different for satisfactory operation, as compared with that which has been considered good practice in connection with saturated steam, piping of the latter kind having failed under superheat in a considerable number of cases. This is partially due to the high temperature involved, but probably in the largest degree to variation of temperature. Observations by thermometer and by recording pyrometer on the outlets of individual boilers and in headers carrying steam from a number of boilers show that the temperature in the header receiving steam from a number of boilers may remain fairly constant while the temperature of steam from individual boilers, even under steady load on the plant, varies incessantly in a large degree. In a particular plant, equipped with boilers and combined super-

heaters designed for 125 deg. superheat over 180 lb. pressure it was found in test with a perfectly steady load, that the superheaters actually gave averages of 89 deg. at one-half load, 139 deg. at full load, and 142 deg. at 50 per cent overload. In actual service with hand firing under variable load the superheat varies 50 deg. in almost any 20-minute period which may be selected. The superheat frequently reaches a value of 225 deg., and from this to zero at the time of cleaning fires.

From his experience, Mr. Kruesi is convinced that under such variable conditions, cast-iron and so-called semi-steel are unfit for use for flanges, fittings, valve bodies or other essential parts required to withstand the steam pressure and temperature in all pipe lines 4 ins. in diameter and larger. It appears that cast-iron fails more on account of lack of elasticity than because of insufficient strength, and this failure is due to incessant and rapid variation in temperature rather than to high temperature. The fact that grate bars and stove plates warp and crack is a matter of common observation and is due to the wide range of temperatures to which they are subjected. Cast-iron has been known to enlarge in volume as much as 40 per cent and in linear dimensions as much as 8 to 10 per cent when heated through wide ranges in temperature, such as occur in annealing ovens. Mr. Kruesi has removed cast-iron fittings which had taken a permanent set, increasing in length from 1 to 2 per cent inside of a week's time. Numbers of valves of the globe type made of semi-steel have increased in dimensions to such an extent that the seat ring of a 6-in. valve, for example, originally threaded tight in the body, could be lifted clear of the threads when cold, representing an enlargement of the diameter of the body at the seat ring of over 3 per cent. It is generally believed that water may exist in the presence of superheated steam under certain conditions, and it is probable that such difficulties with cast-iron parts are chiefly due to the occasional spraying of highly heated interior surfaces with water carried by the steam, resulting in extremely rapid local cooling of considerable extent, which would fully account for radial cracks in the flanges, generally the first evidence of distress. This belief is confirmed by the observation that in a certain header receiving steam from individual boilers through side openings in cast-iron header manifolds, so that steam and entrained water impinged on the sides of the manifold opposite the openings, replacement of the manifolds has been necessary. Semi-steel angle valves in which water, when present, can impinge on the inside surface of the bonnets, have failed similarly. On the other hand, straight cast-iron fittings carrying the same steam have proved satisfactory, the only difference being that they are arranged vertically; and, the flow of steam through them being parallel to the sides of the fittings, there is no impingement or local cooling.

It is undoubtedly true that cast iron has given satisfactory service in superheated steam lines in a number of plants, and this will not appear contradictory to the experience in other plants where it has been unsatisfactory, if the explanation offered above is correct. It is wrong to regard cast iron as safe, because it has in many instances given no trouble. The rapidity with which it will go to pieces will depend largely on the nature of the service as regards fluctuation in load and consequent fluctuation in temperature and priming of boilers. That it will ultimately become unsafe for use seems inevitable, but the danger may not be discovered until serious results ensue, for the reason that such fittings are usually completely covered with heat insulating materials. It cannot be assumed that cast iron is safe for use up to the time that large cracks occur and are detected. Fittings have been found in which the most careful examination would disclose only minute cracks, but the fittings could, however, be readily broken up with a light hammer.

As stated it seems probable that smaller piping, say 3½ inch and less, can safely be made with cast-iron flanges and fittings and other parts as well as valves of brass of good composition. The reasons for the more satisfactory behavior of these materials in such small sizes are probably as follows: such lines are generally remote from the boilers; and, on account of radiation, the superheat of the steam they carry is generally less, consequently the temperature variation which they undergo is materially reduced. These small lines usually contain many bends and fittings; and, being more removed from the boilers, sufficient time probably elapses for water carried over with the steam to be more or less completely evaporated into steam. The bends and fittings undoubtedly contribute to the evaporation of such water. The effect would be to lower the superheat, and such fittings having smaller flanges and thinner walls will be of more nearly the same temperature inside and out when water happens to strike them.

Attempts have been made to find a clue to the reason for cast iron being unsatisfactory, in the chemical analysis of parts which have cracked or warped badly; but the reason will probably be found in the lack of elasticity inherent to all cast iron.

Cast steel has been in use for fittings and valve bodies for a considerable number of years and has, in some cases, caused trouble on account of cracks, splits, blow holes, sand holes and other foundry defects which were not at first apparent, but which manifested themselves after the lapse of time. The trouble in some instances was due in part to making steel castings from patterns designed for cast iron; but such difficulties are now infrequent and can be minimized by correct design. Open hearth castings are preferable to converter castings because of their higher elastic limit.

Gate valves of various makes have proven in many instances practically worthless after short periods of operation under superheated steam. This is often due to their being used incorrectly. A gate valve with solid plug will seldom seat truly unless placed in a horizontal pipe line with the spindle vertical and the hand wheel on top. Any other arrangement of the valve is practically certain to cause the plug to rotate about its center line so that its faces will not be parallel to the seats, hence it cannot close tightly. Any warping of the valve body on account of its very unsymmetrical shape will have the same effect, and gate valves are open to objection on this account even when made of steel. It therefore becomes an object to return to the use of globe and angle valves wherever possible, it being generally practicable to re-grind or re-face the seat of such valves in place without breaking joints. The discs can, of course, be readily removed and re-faced in a lathe. Stems, seats, discs, and other internal parts are frequently made of bronze or nickel bronze. These materials become very "short" at the temperatures under consideration and have a coefficient of expansion approximately 50 per cent greater than that of steel or iron and hence quickly become loose and lose their fit. The operating valves of Curtis turbines have for some years been made of mild steel, seating on seats of the same material, and have after extensive experience proved most satisfactory. These seats have the same coefficient of expansion as the steel bodies in which they are mounted and have never become loose. It is well known that steel retains its elasticity practically unimpaired at the temperatures commonly employed in superheated steam work. Experience may prove that nickel steel alloy containing a high percentage of nickel is preferable for seats and discs on account of less corrosion, but nothing in the writer's experience indicates that this will be the case.

The statements concerning cast iron and steel apply to pipe flanges as well as fittings. Gaskets of corrugated copper are in common use, but these have not stood up well in superheated steam work, chiefly because copper anneals at a temperature as low as 600 degs. F. or about 220 degs. superheat above 180 lbs. pressure. Corrugated gaskets of any kind are open to the objection that careless pipe fitters in making up a joint can readily overstrain the bolts and flanges. Gaskets of asbestos and rubber compounds or other organic material, while often temporarily successful, can seldom be regarded as permanently satisfactory. The most satisfactory gasket is one of thin sheet steel not more than ⅝ in. in radial width, so that heavy pressure can be brought on it with bolts and flanges of ordinary weight; the steel being soft annealed so that it can be pressed into the rough surface of the abutting flanges with a reasonable tension on the bolts.

LETTERS ON PRACTICAL SUBJECTS.

THE GENESIS OF A DAY-CIRCUIT.

The importance, to the central station, of a day-circuit for the operation of motors, heating devices and other modern conveniences and necessities is now well recognized, much more so than in the beginning of the industry. The writer recalls the difficulties under which such a circuit was begun, and believes that a brief account will not be without interest.

Early in the nineties a small Edison station in Ohio was struggling to make ends meet, under the pressure of gas competition, and handicapped by an inefficient generating system and lamps. The station was operated from sunset to sunrise, and the idea of day operation had not entered the minds of those in charge. An electric railway having just been constructed, the station contracted to operate the generator for the railway company; this made it possible to use the boiler plant 24 hours a day.

At this juncture a business man, whose office was unusually hot and poorly ventilated, desired to be furnished with a fan motor. He was informed that it was not possible, as the railway voltage was too high for the satisfactory operation of a desk fan, and it was out of the question to run a 100-hp engine to provide 110-volt current for one fan motor. He was not to be put off, but insisted that in some way it ought to be possible to supply his need. The superintendent of the plant had

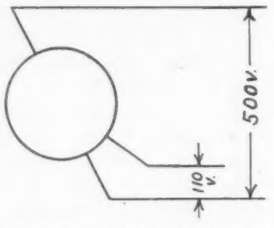


FIG. 1.—THREE-BRUSH ARRANGEMENT.

recently been studying the theory of the dynamo, and it occurred to him that as the railway generator was in operation all day it might be possible to put a third brush on the commutator, at such an angle in advance of the negative brush as to have a voltage of about 110 above the negative brush.

This was done, as shown herewith, the proper position being found by trial. To avoid excessive sparking, the brush was made of carbon and filed every day very narrow at the tip. In spite of this precaution, the commutator heated considerably more when this brush was used.

The fan motor was in the same block as the station, so the wiring was easily accomplished and the service was begun. The voltage regulation proved to be unusually bad, very much worse than that of the main voltage of the generator. This was due to the shifting of the neutral point with changes of load. While very objectionable, it did not prevent the service from extending and soon several desk fans and a ½-hp motor were in regular operation. This last was in a restaurant with a day and night service, so it was necessary to change the motor circuit over from the railway generator to the Edison system when the latter was started in the evening. It was desirable to change to the Edison system whenever the latter was in operation (as on a cloudy afternoon) on account of the steadier voltage. To make the change automatically a switch was constructed having U-shaped copper links which dipped into mercury cups. Two such links were used, one at each end of a pivoted lever, which was loaded so as to drop at one end, putting the day circuit in connection with the third brush of the railway generator. On the other side of the pivot was hung an iron core which entered a solenoid below. This solenoid was connected to the Edison circuit, and when the latter was started up the solenoid tipped the lever and transferred the day circuit to the Edison system. This device operated quite well for a while, but as the load on the day-circuit increased, trouble occurred in the shape of arcing, which made it necessary to discard the automatic switch for an ordinary knife switch.

The increase of load made it more difficult to keep the narrow third brush in good order, and as a ¾-hp motor was on hand, it was belted to the railway engine and used as a generator, a compound winding being added to help the regulation. This gave much better regulation than the third-brush scheme, though the service was still far from good. This small generator was overloaded at the start, and the load kept on increasing. To keep the armature from burning up a small fan motor was arranged to blow a current of air on it; by this means it was possible to carry more than 100 per cent overload. The commutator showed considerable wear, but as the machine was the first of its kind to be operated in the station, there was no knowledge as to the safe depth to which the bars could be worn. One day the engineer came hastily into the superintendent's office with the rather startling announcement that the little generator was slinging its commutator bars out on the floor, but was still carrying the load. A hasty inspection showed this to be very nearly true; the machine was still carrying the load, although the voltage was not fully up to normal. Commutator bars, in halves, were scattered over the floor, and the brushes were sparking considerably. The brushes had cut the bars deeply in the center of their lengths, the half-bars thrown out were the outer halves, the inner halves being held in place by the leads and the bands over the leads; the brushes were running on the remaining half of the commutator. This state of affairs continued for five or ten minutes when the half-bars next to the leads commenced to get out of place and the long-suffering machine went out of business.

In the meantime, however, a contract had been made with one of the local newspapers for the installation of a 3-hp motor, and this had been purchased and was on hand, as well as a 6-kw bipolar Edison generator, which was to run the day circuit. This latter machine was quickly put in position and set to work.

A short time later the new printing press was installed and the 3-hp motor set up to drive it. Here a new difficulty arose. While the 6-kw generator was compound wound and would give good service when driven at a steady speed, it could not give a steady voltage with the wide variations of speed of the railway engine, which was of only 100 horse-power. The factory expert who set up the printing press tried to operate it with the motor, and on discovering the large and sudden variations of speed, promptly notified the lighting superintendent that he would never "hook up" his press to such a motor, as the press would be "racked to pieces in less than a week." This was a serious situation; two machines had been bought for the work and failure here would probably end the day-circuit. As the press expert further announced his intention of leaving the next day without connecting the press to the motor, the situation was clearly critical, and something had to be done. As a forlorn experiment, a man was stationed at the field rheostat of the 6-kw generator, with instructions to hold the voltage as near constant as possible; the press man was then invited to try the motor again. He reported it still unsatisfactory. It was evident that something must operate which was quicker than hand control. The superintendent burned the midnight oil later than usual that night. Early the next morning he procured a supply of heavy insulated line wire, removed the keeper joining the upper ends of the field cores of the 6-kw generator, and wound one layer of the heavy wire over the existing winding. The ends of this new winding he carried over to the 60-kw railway generator and connected them to the ends of the series field of the latter, so that when a heavy load came on the railway generator part of the current would flow through the auxiliary winding on the 6-kw generator. By disconnecting this auxiliary winding the range of voltage variation without it could be noted; on connecting it, it was found that the regulation was considerably improved. So another layer of thick wire was put on the 6-kw generator field coils and put in parallel with the first.

The regulation was still better, but not quite good enough, so a third layer was put on; this gave a very satisfactory result. The printing press man was now notified that a change for the better had been made. He connected the press to the motor and declared himself entirely satisfied.

This generator, thus compounded for variable speed as well as variable load, ran for a considerable time and gave no trouble. The effect upon the regulation of the 60-kw railway generator was not determined, but no one expected any sort of regulation from it, so there was no complaint.

From this on the day-circuit began to prosper. Small job printing offices were equipped with motors, and the electric fan motor began to get a good grip on the company's customers. The demand for larger motors became such that it was considered feasible to operate the day-circuit from one of the regular engines used for lighting service at night, especially as a favorable flat rate for fuel had been obtained from the natural gas company.

The day load of this small station, as operated from the three-wire Edison circuits, now averages over 60 kilowatts, and is recognized as a paying part of the load. There are about 300 horse-power of motors installed. The town is a manufacturing one, with a number of small industries which can use electric motors to advantage, but which are located in the outlying districts beyond the reach of the direct-current system. The lighting of these districts has been done in the past with the 125-cycle system. Recently, however, the company has thrown out its 125-cycle machine and put in two 60-cycle, three-phase machines, so as to be able to push the motor business in the outlying territory, the value of the motor load being fully recognized.

WASHINGTON, D. C. H. B. BROOKS.

SOME NOTES ON FURNACE ARCHES FOR WATER-TUBE BOILERS.

Central station engineers, particularly those who have to encounter during certain parts of the day big loads which test the capabilities of the boilers to their uttermost, will have at one time or another experienced the disastrous effects which result from the falling in of the furance arches. It is, therefore, perhaps useful to consider a few points which regulate the proper construction of these arches, more especially as the work is often left to the tender mercies of the average bricklayer, whose sense of responsibility is usually not so great as it might be.

When building the arch, whether for grates 3 ft. or 6 ft. wide, the bricks should not only be accurately fitted onto the template before being built into the boiler, but it is necessary to rub down each brick so as to make a true face with its neighbor. By doing this it is possible to make the fireclay joint very thin, and as nearly all of the failures of arches occur through bad jointing, the importance of this point can be easily seen. The bricks being faced true to one another enable the arch to stand a long time and to keep from dropping even if slight bulging takes place, due to intense heat and strain on the boiler setting. Great care should be taken that the skew back bricks, which take the thrust of the arch, are properly bedded. A common failing of inexperienced bricklayers is to pack these behind a considerable amount of fireclay. If the bricks crumble away at all, or shift with the heat, the lumps of fireclay are not in themselves able to resist the strain and the arch itself will fall. The proper way to build an arch, if it is intended to last, is to construct two arches, one above the other, each of 4½-in. brickwork, the two arches being quite independent of one another. This can be done as follows: First, build the lower ring on a wooden form in the ordinary way, then spread evenly all over this a layer of dry fireclay, or, better still, sand, to a depth of three-quarters of an inch; on this sand build the second ring of brickwork. When the job is completly set and hard the layer of sand or dry fireclay between the two arches can be raked out, thus leaving a clear air space. This has two advantages; the first being that the upper ring and the brickwork above it are kept much cooler than with the solid arch, and the second one being that if the lower ring burns out and drops, a new one can be built at comparatively small expense without disturbing any of the other fireclay. The writer is now building all his arches on this plan, and whereas the renewal of solid arches used to cost about $50 per year per boiler, one arch now lasts two years and even then has to have the bottom ring rebuilt, which costs about $15 every other year. There is therefore, a saving of $42.50 per boiler per annum.

When building the side walls of the furnace in a new boiler an excellent plan is to include in the firebrick lining an arch springing from the back end of the grate and rising to about the bottom row of tubes. It is really a part of the sidewall and is, of course, built in with the other brickwork, but the object of this construction is that if the side walls burn away beyond the end of the arch, they can be cut away and renewed without incurring the danger of the side lining walls falling. As is well known, if these walls fall it is a very expensive matter to rebuild them, inasmuch as it involves cutting away the outside walls of the boiler, owing to the fact that it is impossible to rebuild the lining from inside, the tubes being in the way. The construction, therefore, of an arch, such as described, is a great money-saving contrivance in the up-keep of a boiler.

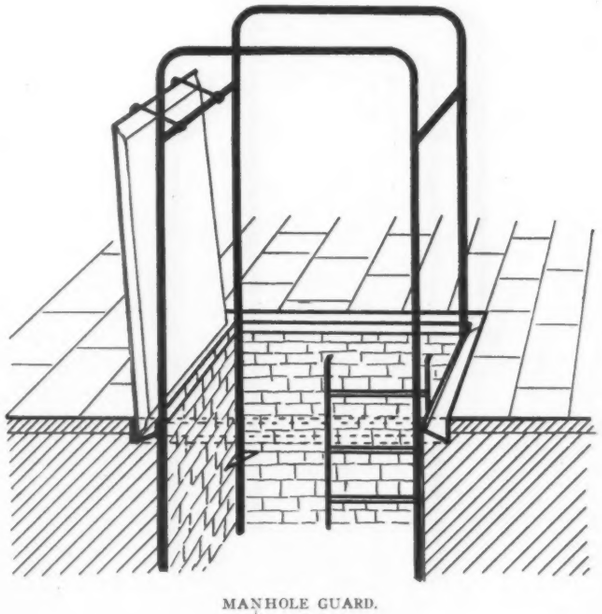
Common salt should always be mixed with the clay when building furnace arches or walls, as it glazes the bricks when subject to the intense heat of the fire and prolongs their life to a very considerable extent. The correct proportion to use is about 10 lbs. of salt to every hundred weight of wet fireclay.

Attention to the above points when constructing and rebuilding furnaces for B. & W. and similar types of boilers will get rid of a good many of the troubles which sometimes worry the life of an engineer in charge of a central station and throw discredit upon the supply given.

NEW YORK. S. A. J. BLACKETT.

THE INSPECTION OF MANHOLES.

In the provision of an underground network of electric cables in a city an important point which has reference to the cost of maintenance is the ease with which the system can be inspected. In modern equipments the provision of inspection boxes in the street is almost universal, and the covers of the



MANHOLE GUARD.

boxes being small, can easily be operated by one man. When, however, the growth of the system necessitates the placing of underground transformers at various points, the case becomes different. The openings into the streets have to be sufficiently large for the admission into the chamber below of any transformers or regulating gear that have to be placed therein, and the work of lifting the covers for a manhole of this sort is

considerably harder than in the case above-mentioned. In the old-fashioned type of cover, which has to be removed or tilted back, and which was sometimes too heavy for a single man to handle, an inspection of the system by a single individual was an impossibility without calling in the aid of any chance passer-by to lift the cover and guard the hole in the pavement. The illustration shows an arrangement whereby, with a light cover and an easily constructed lifting guard, a quick inspection of a manhole by one man is easily possible. The cover is so constructed as to rest in any one of the small grooves which surround the manhole in order to drain the water, and is held in position by two hooks attached to the lifting frame. The frame or manhole guard can be made from ordinary gas pipe in order to secure lightness, and is fitted into angle pieces in the masonry work of the chamber in order that it can be pulled up or pressed down. When the guard is down it lies close to the wall out of the way of gear, when this is being lifted by slings up or down the opening, and when up can be arranged to be pinned up or alternatively can be held up in position by the hooks which hold the manhole cover vertical. It will be seen that this cheap and easily made device prevents all possibility of passersby falling down the opening.

Newcastle-on-Tyne, England. J. A. Seager.

INCANDESCENT LAMP EFFICIENCY.

A little experiment which I made the other evening has resulted in my looking up data pertaining to incandescent lamp illumination, which I give with the thought that it may benefit others to the same extent that I myself have been benefited.

I recently had my residence wired and in equipping the sockets with lamps I purchased 50-watt Gem lamps of 20 candle-power each. Taking a notion to ascertain the difference between this high-efficiency lamp and ordinary 16-cp lamps, I obtained four of the latter, and shutting off all lamps throughout the house the 16-cp lamps were placed in sockets and the revolutions of the revolving disc in the meter counted for one minute. The result was that the discs made eight revolutions per minute with four 16-cp incandescent lamps burning. The 16-cp lamps were then removed, and the Gem 20-cp lamps placed in the circuit with the surprising results that the revolving disc made but six complete turns to the minute, which indicated beyond doubt that it is more economical to operate four 20-cp Gem lamps than to operate four 16-cp lamps with the ordinary filament. To say that I was surprised goes without saying.

As I have never noticed how many revolutions of the disc are made per kw-hour, I am unable to state just what the saving will be in using the one type of lamp in preference to the other. It is evident, however, that a considerable saving will be brought about in a year's time when the illumination of the entire house is taken into consideration and the 50-watt Gem lamps are used.

In looking up information regarding the efficiency of lamps I found that the amount of energy used by the Gem metallized filament type of lamp is considerably less than that consumed by any low-efficiency lamp, which proves that the experiment as tried, and which was repeated several times, was correct.

TABLE, SHOWING SAVING BY THE USE OF HIGH EFFICIENCY LAMPS.

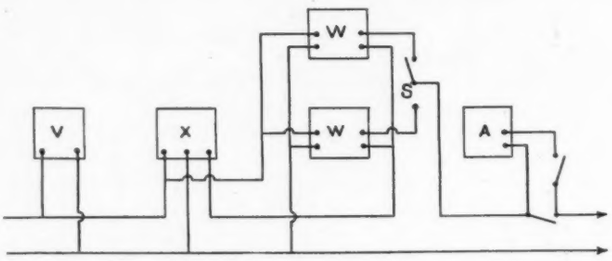
	Carbon.	Carbon.	Gem.	Tantalum.
Candle power	20	20	20	20
Watts per candle, nominal	3.5	3.0	2.5	2.1
Watts per candle, actual	3.48	3.04	2.5	2.1
Total watts	69.6	60.8	50.0	42.0
Hours' total life	1040	520	560.0	600
Cost of lamp	$0.16	$0.16	$0.20	$0.54
Cost of renewals per year of 1000 hours	0.154	0.308	0.36	0.90
Cost of energy per year of 1000 hours, at 10c. per kw-hour	6.96	6.08	5.00	4.20
Cost of energy and lamp renewals per year of 1000 hours	7.11	6.39	5.36	5.10
Saving over 3.5 W.P.C. lamp	.....	0.72	1.75	2.01
Saving over 3.0 W.P.C. lamp	.....	.....	1.03	1.29

The table shows the saving by the use of high-efficiency lamps. The figures given in line five are not guaranteed, but are taken as an average figure; some lots of lamps being less efficient than others, which, of course, will make a different average for each lot of lamps. The Gem lamp, according to my observation, gives a practically white light with but a slightly yellowish tinge, while we all know that the carbon incandescent light at normal voltage gives a yellowish white light, and when below voltage an orange to an orange-red light.

Turtle Creek, Pa. James Ashburner.

TESTING WATT-HOUR METERS.

In reference to the plan of meter connections shown in Fig. 1, page 45, of Electrical World for January 4, Mr. Fred Dubell states that "If it is desired to use the upper indicating wattmeter, open the single-pole switch, and when using the lower instrument close the single-pole switch." It will be seen that with the switch closed the current coils of the two indicating wattmeters are in parallel, and hence the current will



TESTING WATT-HOUR METERS.

divide between them inversely as their resistances. The current coil of the lower wattmeter, of five amperes range, would thus be shunted by the much lower resistance of the 25-ampere current coil, and the test at light load would be greatly in error.

The plan of connections may be modified as shown in the accompanying illustration, by substituting the double-throw switch *S* for the single-throw switch shown by Mr. Dubell. When using the upper wattmeter this switch is thrown up, and when the lower wattmeter is needed the switch is thrown down. In all other respects the plan shown herewith is identical with that of Mr. Dubell.

Washington, D. C. H. B. Brooks.

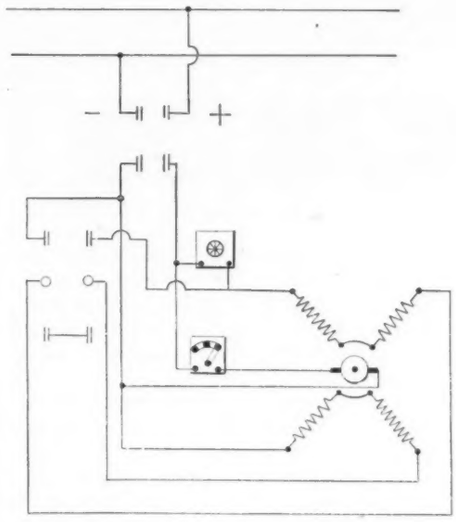
MOTOR SPEED VARIATION.

In some places where electric motors are used the speed variation required is not very great and for constant speed a small starting resistance only will be required in the armature circuit. There are many cases, however, in which a wide variation of speed is required and the motor must be kept at such speeds for considerable periods. Therefore the resistance, if any are used for speed regulation, must be designed to carry the current continuously without danger of burning out or overheating. For speed regulation within narrow limits, such a method might be practical; but where a large speed variation is desired, the resistances needed are ordinarily too expensive and cumbersome.

In shops where there are many large machine tools, separate motors are used for each tool, and in such cases, where a wide speed variation is required, a different method of control is used. Sometimes a three-wire system is used with 220 volts across the outer wires and 110 volts between either outer and the center wire so that a motor may be driven at either full or half speed and speed control given at both speeds. Another method calls for the use of two motors on each large machine tool on a two-wire circuit and various motor combinations in series or in multiple with or without series armature resistances. A wide speed variation may be obtained by this means; but the method is ordinarily expensive and complicated.

A convenient and simple arrangement for a wide speed variation, either with or without the use of the three-wire, double-voltage method, is shown herewith. A field resistance and an automatic armature starting resistance are used. Two switches are provided—one a double-pole, single-throw, main switch from the line and the other a double-pole, double-throw switch for the field coil circuit beyond the main switch. A four-pole

motor is indicated and the field coils are in a divided circuit, two coils to a circuit. By means of suitable connections, the field coils may be arranged in multiple or in series and with the proper resistance adjustments in the field coil circuit and with an arrangement such that this change from multiple to series connection will give a wide variation in the field strength, a corresponding variation in motor speed results. The adjustments should be such as to have the field cores near saturation



CONNECTIONS FOR VARYING SPEED OF MOTOR.

when the field coils are connected in parallel. Of course the starting resistance in the armature circuit should be arranged to be open circuited when the motor is at a standstill, and this should preferably be brought about by means of any of the well-known forms of starting boxes which are arranged to open the circuit automatically.

As shown in the diagram the field coils are in series when the double-throw switch is in the lower position and in multiple when the switch is in its upper position. With the field coils in series the speed is approximately double the speed with the field coils in parallel. This presupposes a well-designed motor. With many makes of motors this change in connections may result in sparking at the commutator owing to the weakened field. However, many makes of motors are on the market with speed ranges of 3 to 1 obtained by weakening the field, and these operate quite satisfactorily.

BROOKLYN, N. Y. H. M. WILLIS.

A WASTEFUL ECONOMY.

Some time since, in a large electrical manufacturing plant, the writer noted that the water pipes in all of the sinks and drinking places through the factory had recently been fitted with self-closing bibb valves. It was also noted at the same time that every man who came to the faucet to take a drink would stand for three to five minutes at the sink, holding the faucet open and letting the water run a stream the full size of the opening until the water became cool enough to drink.

The extreme newness of all the bibb valves led the writer to become somewhat curious and to make inquiry as to the reason therefor. He at once ascertained that until very lately the water pipes had been supplied throughout with globe stop-valves, and that the water had been allowed to run in a continuous, though small stream all day, in order that it might be cool enough for drinking purposes.

It was noted that every man who came to drink held the faucet open from one to five minutes, no matter if the last man had but just gone. Upon inquiry it was found that the manager had found the water in three or four places all running streams as large as a lead pencil, and had straightway ordered self-closing valves placed upon all the sink pipes. It was also ascertained that the water cost 35 cents for 1000 gals., and that the manager read a grievous lecture to the superintendent upon the very great waste of water in the factory.

The writer became considerably interested in the matter of the economy secured by the use of the bibb valves and made a few experiments to obtain data from which to calculate the actual saving secured by putting on the bibb valves. First, one of the bibbs was blocked open to pass a stream about the size of that, which, according to the superintendent, used to flow from the old valves. The stream thus flowing was timed for a minute and the water caught in a bucket and weighed. It balanced the beam at exactly 4 lbs. Next, one of the new bibbs was held open as the last man up had held it, and the bucket failed to hold a full minute's run, therefore the valve was held open for 12 seconds, and upon weighing, 8 lbs. of water was found in the bucket.

Calculating from the above data, it is found that the water will run 240 lbs. an hour, 2400 lbs. a day of ten hours, amounting to 288 gals., which at the usual rate of 35 cents for each 1000 gals. would amount to the princely sum of 10 cents a day. To make a possible saving of 10 cents each working day, the management went to the expense of $1 for each of the bibb valves. It was found that the average time spent at the valve while waiting for the water to run cold was three minutes, and that a mechanic came five times a day, making 15 minutes each man spent at the faucet. The ten men would spend 150 minutes daily, or 2½ hours, holding that valve open. The men averaged about 20 cents an hour, making the valve-holding cost amount to 50 cents each day. Here was economy—the saving of 10 cents already cost 50 cents, with more expense to be estimated.

The water flow of 8 lbs. in 12 seconds equals 40 lbs. a minute, 240 lbs. an hour—just equal to the entire day's water expenditure with the steady stream. This gives $1 a day for cost of water with the water-saving bibb valves. Added to the 50 cents cost of time, the total expense is $1.50 a day, against the small expenditure of 10 cents. "But," says the manager, when confronted with the figures given above, "it is by no means certain that the permanent stream would always be as small as a pencil and flow only 4 lbs. each minute. The men would as soon leave the valve wide open as nearly closed."

It is very easy to arrange the piping so that no more than 4 lbs. a minute can flow, no matter how the valve is left. Just remove the valve, place a plug in the pipe, with a hole through the plug as large as desired, and no more water can flow, after the valve is replaced, than can get through the opening in the plug.

Stopping the small leaks around a power plant or a factory is something to be commended in any manager, but sometimes the matter needs very close study in order to make the proposed amendment of greater economy than the old arrangement—another place where brains are at a premium.

SCRANTON, PA. JOHN SCOTT.

SETTING OF DYNAMO BRUSHES.

Mr. Wakeman in his articles in the December and January issues, entitled "The Operation of the Small Electric Plant,"

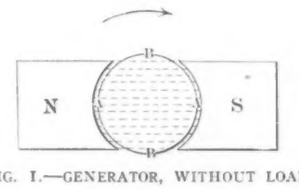


FIG. 1.—GENERATOR, WITHOUT LOAD.

leaves an erroneous impression as to the correct setting of dynamo brushes, since he states that these should be adjusted until the desired voltage is obtained. When setting dynamo brushes, the correct method is to move them back and forth while the dynamo is running until a position is reached where the brushes do not spark at all; or if they spark the amount

in that position is a minimum. This is called the neutral point and the brushes are set in this position without regard to voltage. Fig. 1 represents a bipolar dynamo running in the direction indicated by the arrow, at no load. Under this condition the lines of force flow through the armature as indicated by the dotted lines. The greatest voltage, therefore, is generated in the coils at *AA*, directly opposite the poles; and in the coils *BB*, which are at right angles to the coils *AA*, no voltage is generated. This position is called the neutral position at which the brushes should be located in order to provide sparkless commutation. Fig. 2 represents the same dynamo under load, and because of the current flowing through the armature winding, the lines of force will be displaced as indicated. The maximum voltage, therefore, will be generated in the coils at *cc*, and consequently the neutral position will be at *dd*. It will thus be seen that the neutral position varies somewhat as the armature current varies. This variation being smaller, the stronger the field is in proportion to the armature reaction.

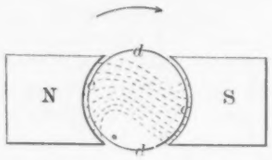


FIG. 2.—GENERATOR, WITH LOAD.

Wyoming, Minn. Carl Gardeen.

ERRORS IN CONNECTIONS WHEN REPLACING AN OLD DYNAMO.

The accompanying wiring diagram shows the connections found by the writer a short time ago when called on a "trouble notice." A new generator had been installed in the place of an old one, and the old wiring was used. The generator had apparently started all right. A light load only was available and this load was put on the machine. The meters indicated in the right direction so that the machine was left as being properly connected. When the charging switch for the storage battery was closed the next day, the "fireworks" began. The trouble was speedily remedied; the generator fields were reversed and leads 1 and 2 were interchanged.

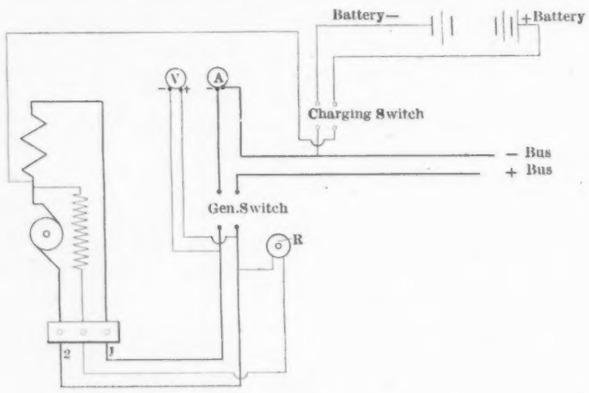


DIAGRAM OF GENERATOR CONNECTIONS.

Worcester, Mass. C. W. Kenney.

SERVING ROPE ENDS.

Judging by the attempts recently witnessed by the writer of the attempts by an electrical worker to serve the ends of several cords or ropes used for suspending arc lamps, a little instruction in that simple matter may not come amiss. The worker in question said he was "winding rope ends," but the proper nautical term for the process is "serving."

The ropes in question were ½-in. in diameter, and the worker was trying to wind about 1 in. of the rope, close to the end, using light string for the purpose. But trouble came when he attempted to fasten the ends of the winding string. The rope was secured in the vise during the winding operation—something unnecessary when the proper method of serving a rope is followed. The process of serving is as given in the following description.

The rope end is first closely wound, twisted and packed together, a very necessary operation if the rope has been somewhat frayed before the serving operation is commenced. After the rope strands have been all laid in place, tie a bit of string very close to the end of the rope, to hold the ends until the serving fastens them. Select a piece of string about 50 diameters of the rope in length—this string is for the permanent serving.

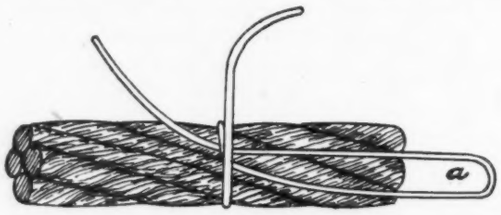


FIG. 1.—BEGINNING THE "SERVE."

The worker, while under observation by the writer, tried all manner of ways of fastening the strings—all except the right way, and he would begin with one end of the string fastened, wind, and then attempt to half-hitch the other end of the string. Again he would commence in the middle of the serving string, wind both ends alternately, crossing them over each other at every turn. At the end of the winding, a square knot was tied, which presented a lump so ugly that it only required an opportunity to break off and let the serving fall off.

The proper way to start a rope-serving is as shown by Fig. 1, the string being given a single turn around the rope and the end made into a loop as shown at *a*. The successive windings hold the loop securely and after the winding has progressed to the end of the rope, the winding end is passed through the loop, as shown in Fig. 2, then the string is cut off and the beginning end of the string is pulled tight, causing the winding end to be pulled under the winding, as shown in Fig. 3, until it is half way through the winding.

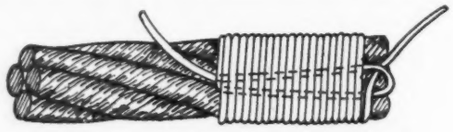


FIG. 2.—ENDS READY FOR FASTENING.

Care must be taken lest a too sudden pull on the string should cut it in two just inside the loop. When the string pulls heavily, a little pulling of the ends, back and forth, will so loosen things that the loops may be pulled halfway through the winding without danger of breaking either of the string-ends.

The illustrations herewith presented show the application of soft wire serving to the ends of wire cable. This operation is performed in exactly the same manner that the rope serving is done, and the description applies alike to both operations. The cables shown in the engravings were to be used for suspending arc lamps out of doors, while the ropes mentioned in the text were used inside the factory for the same purpose.

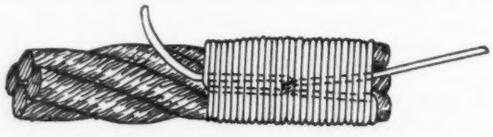


FIG. 3.—ENDS FASTENED.

New York City. James Francis.

QUESTIONS AND ANSWERS.

I have a few holes in a marble switchboard which I wish to plug up. Kindly inform me of a mixture that I may use for this purpose.
R. T. S.

Mix four parts of gypsum and one part of finely powdered gum arabic, and with a solution of borax, make a mortar. This may then be inserted in the holes in the marble. If the marble is colored and the holes are large, coloring matter to match may be added to the borax solution.

What effect has the operation of synchronous motors on a transmission line? T. H. N.

A synchronous motor having its field excited beyond the amount that will give normal operating voltage, takes a leading current from the line. This leading current offsets or neutralizes lagging current such as is taken by induction motors or the drop in voltage resulting from the inductance of the line. In the latter case the synchronous motor acts as a capacity load. If the synchronous motor is underloaded this neutralizing of lagging current is relatively greater than when the motor is under load, so that oftentimes companies operating transmission lines have synchronous motors running idle connected to the line or offer inducements to motor users to install synchronous rather than induction motors.

In the design of electrical apparatus, is not the size of the air gap more of an electrical than a mechanical consideration? For instance, would not a machine operating under wide variation of load, designed with a large air-gap and heavy field, be but slightly effected by armature reaction? E. N. S.

Although the effect of armature m. m. f. upon the field strength depends somewhat upon the air-gap, this effect is not of predominating importance. When commutating poles are used any effect of the m. m. f. of the armature is fully compensated for throughout the commutating zone, so that machines provided with commutating poles can be built with air-gaps as small as mechanical limitations will allow. Even in standard machines without commutating poles the air-gap is usually made as small as possible, armature m. m. f. being rendered of small importance by using a minimum number of armature turns and a maximum field strength, in order to obtain the required e. m. f. Many of the early generators, however, were built with very large air-gaps in order to prevent sparking at excessive overload.

I have a clock and some recording gear actuated by electro-magnets in a permanently air-sealed housing or box. The mechanism is assembled on its containing base and the cover is secured on the base, rubber gasketted, in a heated chamber in partial vacuum in an effort to preclude rusting of steel gear and other parts. The pinions and bearings will receive a slight coat of sperm oil. The apparatus will be mounted out of doors on a column and will be subject to the extremes of our climate, and it is my desire to keep it sealed and undisturbed for a number of years, granting the only breakdown factor to be that of frictional wear. As a further preventative, I contemplated inserting a small quantity of some salt or calcium carbide, etc., as an absorbent; but am afraid of disintegration, due to deliquescence, etc. What compound should I use?
A. A. I. E. E.

It would appear that having taken the precaution to make the case air tight, it might be filled with some inert gas. However, slacked lime, powdered carbon, alcohol, and many other substances have quite an affinity for water and any of these might be introduced into the case for the purpose of keeping moisture away from the mechanism. With the steel parts oiled and in a dry atmosphere it is not likely that they will rust. If oiling of the steel parts is not desirable try the plan suggested in the answer to J. K. in the December number.

In a ¼-hp Emerson alternating-current motor there is a device that opens a circuit by centrifugal force when a certain speed has been reached. What is this for, and what happens when it works? In wiring single-phase watt-hour meters the potential leads have to be reversed sometimes to get the movement in the right direction, and this is also necessary in polyphase meters, which will either run wrong or not at all if the potential leads are reversed. Please explain why this is so. T. F. E.

The motor, which is a single-phase machine, is brought up to speed by means of starting coils in the field winding. The current in the starting and running coils are out of phase with each other, so that the result is a sort of rotating field and the rotor is dragged around with accelerating velocity until it attains normal speed, when the centrifugal force acts to cut out the starting coils. A single-phase motor is not ordinarily self-starting, so that the starting coils convert it for the time being into a two-phase motor. The torque exerted in the meter is proportional to the product of the instantaneous values of current and potential. The shunt-connected coil produces a flux causing eddy currents to exist in the disk and the series-connected coil produces a flux in such a position that a driving torque results at the disc. If, therefore, the potential leads are reversed the time-direction of the eddy currents is reversed and the torque is reversed so that the meter disc revolves in the opposite direction.

How may gas leakage be easily detected? We have lately had a number of explosions in our manholes, some of which have been quite violent, although no damage was done. This we attribute to illuminating gas. How can these explosions be prevented? F. J. K.

The method employed by gas companies in testing for leaks is to drive a bar, or "needle," as it is technically termed, into the ground over the gas main and to follow this up with a series of holes until the flow of gas becomes free, when the tester knows he is near a leak. When the bar is withdrawn from the ground, a lighted match is applied to the hole. If the hole is near the leak, the gas will ignite, otherwise it will not. The gas mains may readily be located by electrical means; such as, for instance, by the use of the ohmmeter or by employing an exploring coil and a head telephone receiver. Natural ventilation of conduit systems and manholes will ordinarily prevent explosions. If, therefore, instead of sealing the manhole opening with an air and watertight cover, the cover is left loose with openings permitting of the free passage of air or gas, the gas will be diluted to such an extent as to render it harmless except where large volumes of gas find their way into the conduit system from bad leaks in the gas mains. A modification of the ventilating cover may be adopted in the shape of vent pipes at intervals along the street, which open into the manholes.

Kindly inform me how to measure a high resistance with a voltmeter. I also desire information on a generator giving an e. m. f. of 230 volts on the commutator side, and there are some taps taken from the back of the armature which, when used with either outside wire, permit 115 volts to be obtained. H. G.

To measure resistance with a voltmeter two readings of the instrument are necessary, one with the instrument directly across the source of current, which should also be a source of constant e. m. f.; and the other, with the instrument in series with the unknown resistance across the same source of current. If E is the reading in the first case and E_x the reading in the second case, and if R is the resistance of the voltmeter and R_x the unknown resistance, then $E_x \div E = R \div (R + R_x)$ whence $R_x = R \times (E - E_x) \div E_x$. In the generator under question points in the armature winding 180 electrical degrees apart are tapped by conductors leading to collector rings. An impedance coil having an iron core is connected to the collector rings by means of brushes. The coil is of low resistance, but its counter e. m. f. of self-induction is so great that the alternating current supplied from the collector rings is of small value and very little energy is lost due to this current. A point midway between the terminals of this coil will normally be at a potential which is midway between those of the two brushes on the commutator. A wire may be connected to this point and the receivers connected between this wire and either of the mains, thus forming a three-wire system. Any excess of current on one side over that on the other will be carried by means of the neutral wire and the impedance coil, and will be properly distributed within the winding. While the impedance coil prevents an excessive alternating current, it permits a direct current to flow unretarded.

Suggestions for Obtaining a Motor Load.

By Norman G. Meade.

The promotion of the increased and more extensive use of electric energy for the operation of electric motors as a substitute for gas or steam engines and manual labor, is a subject of much importance to a central station management. It is a well recognized fact that the day load of a power plant, if inadequate, is not conducive to economy and that a concerted movement on the part of the central station management to increase the motor load is a means of increasing the operating efficiency.

How best to secure this desirable business is a matter that should have mature consideration. A careful analysis of local conditions should be undertaken, the various business enterprises classified and a study of the need of each class made, not only as to the advantages that would be gained by the use of electric motors, but also as to the equipment that should be recommended.

In a general way, the same argument can be advanced in favor of electric drive for all purposes; that is, it eliminates belting and shafting to a large extent, reduces friction losses and increases production because of uniform speed and ease of control. These arguments while true are more or less stereotyped and the prospective customer will generally ask what specific advantages would be secured in his particular line of business should he adopt electric drive. The solicitor should give such information without first being questioned, as nothing impresses a business man more than the realization that the person addressing him understands what he is talking about and is able to state his case briefly and concisely.

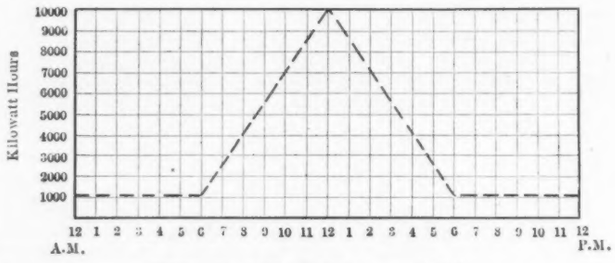
Another desirable class of customers for the central station solicitation is manufacturing companies who operate their own power plants. A small isolated plant cannot generate electricity at as low a cost per kw-hour as the management of a large, highly-efficient station can afford to sell it. When it is considered that one of the largest and most efficient power stations in this country, rated at thousands of horse-power and equipped with practically every economical device known to science, only returns a small percentage of the heat units contained in the coal, to the bus-bars in the form of electrical energy, it can be easily imagined how extremely low must be the efficiency of a small plant with a rated output of a few hundred horse-power. When a manufacturer is approached he will perhaps be skeptical as to the truth of such statements and will generally say that his average fuel bill is a certain amount and help and supplies cost so much, etc. Dividing the total amount by the average consumption in kw-hours, he obtains an attractive showing. Much, however, he has not taken into consideration, such as interest on the investment, rental value of the space occupied by the power plant, depreciation, etc. A conservative estimate of the average life of the equipment of a power plant in 20 years, including boilers, engines, condensing plant, generators, switchboard, auxiliaries, etc. For example, let the value of the complete power plant be placed at $5,000, then the annual depreciation would be $250. The interest on the investment at 5 per cent would be $250. This adds $500 to the manufacturer's figures, not including repairs, rental value, and incidentals. Let the manufacturer again figure his cost on the new basis and the rate per kw-hour will be entirely different.

These arguments are based on the assumption that the central station management is willing to make attractive rates. It may be well to analyze the cycle of operations in a station for 24 hours to see where the general operating efficiency is greatly impaired by a small day load. If a station is intelligently managed, the average cost per kw-hour to generate electricity should be known. Tests to determine such costs are generally based upon average output, and do not take into consideration the peak loads and the light loads. The operating expense with the exception of fuel and possibly one or two attendants is approximately as great during lightly loaded periods as during the peak load. In calculating the actual net profit per kw-hour this should be considered, and should also enter in the fixing of motor rates.

For example, assume that a power station has a rated output of 10,000 kilowatts at peak load. Assume that the total valuation of the equipment is $1,000,000, then the assumed operating expenses, interest, depreciation and labor would be as follows:

Interest at 5 per cent	$50,000.00	per annum
Depreciation on a twenty-year basis	50,000.00	" "
Salary for one engineer, three shifts	4,000.00	" "
Salary for three oilers, three shifts	4,320.00	" "
Salary for five firemen, three shifts	9,000.00	" "
Total	$117,320.00	

This, in round numbers, is approximately $135 per hour for 365 days in the year. Consider this station as carrying a lighting load chiefly and that the accompanying curve represents the average daily load, showing a consumption of 60,000 kw-hours for 12 hours during the peak load and 12,000 kw-hours during the 12 hours of light load, or a total of 72,000 kw-hours



CURVE OF DAILY LOAD AT STATION.

per day, which at a rate of 6 cents per kw-hour would amount to $4,320 per day, or $180 per hour. Allowing 1 cent per kw-hour for fuel and incidentals, this amounts to $720 per day or $30 per hour, which, added to $135, equals $165, the average cost of generating electricity per hour, leaving a net profit of $15 per hour.

For the lightly loaded hours it will be observed that there is a load of only 12,000 kw-hours, yielding a gross income of but $30 an hour. Considering these 12 hours alone there is a net loss per hour of $135 corresponding to interest, depreciation, labor, etc., plus $5 for one hour's fuel and incidentals, or $140, from which is deducted the gross income per hour, $30, leaving $110. At the rate of 2 cents per kw-hour, a motor load of a little over 6000 kw-hours per day would pay all expenses during the lightly loaded hours. This, of course, would greatly increase the net profits during the peak load. While this business is being developed, the low rate could be maintained at some sacrifice to the total net profits, but the ultimate outcome would more than repay the losses suffered during the new motor load campaign.

The foregoing figures are assumed, but serve to illustrate that motor business taken at a very low rate is profitable if enough of it is secured.

Large motor manufacturers are now co-operating with many central stations to aid them in increasing their motor load. Several large motor manufacturers are conducting a resale department by which they endeavor to enter into contract with manufacturers of various appliances which may be adapted to motor drive, to use their make of motors whenever there is a demand for a motor-driven appliance and at the same time the motor company aids the manufacturer by advertising his appliance in connection with the latter's motors. The central station management can help the motor manufacturer by instructing its solicitors to watch closely for extensions in existing manufacturing plants or buildings, ascertain, if possible, what machines or appliances are to be installed, and then to notify the motor manufacturer.

Assume that an elevator is to be installed in a new apartment house. The motor manufacturing company will then communicate with some elevator company with whom it has a contract and the latter's representative will endeavor to secure the

contract. The solicitor for the central station will, in the meantime, talk to the owner of the building regarding the advantages of electric-drive elevators and also follow up the elevator salesman, if he is successful, to close the contract. In this way three companies co-operate to install a motor-driven elevator.

It is always advisable to use high-grade motors only, because they give better satisfaction, and one satisfied customer is worth a dozen who are dissatisfied. Further, in many respects it is desirable to use motors of one make, as better deliveries are generally secured and better prices. It is always advantageous to carry a stock of motors, as the ability to install a motor at short notice is often the means of securing a new customer. Many times there will be a telephone call, and some manufacturer will ask how soon a motor can be set up and connected, as his gas or steam engine has broken down and the plant is idle in consequence. If the station manager is able to reply that the motor will be delivered as soon as a wagon can be procured, the chances are that when once in operation it will never be taken out again. Many customers are lost by poor deliveries, and to be able to say "we can place a motor at once" is a great aid to securing new business.

Business men and manufacturers should not only be looked upon as prospective customers. The housewife is invariably ready to look at popular motor applications, and is frequently susceptible to the station man's argument, especially when she is told that a large washing can be done in a very short time, without her turning the machine, at little cost and that a small motor attached to a sewing machine will run it at her convenience without manual effort.

A well equipped show room near the central part of the city, where motors and popular applications of electricity can be shown to advantage, is especially recommended. This display can, of course, be supplemented by heating and cooking appliances and various lighting fixtures.

The exhibit of popular motor applications should be as varied as possible, so as to interest a large number of people. Manufacturers of different classes of machines will often gladly cooperate with light and power companies in such an exhibit, by loaning machines for a short time at least. The majority of the business secured through the agency of exhibitions is the addition of motor and heating appliances for household and business use. The attendant draws a lady's attention to an ironing machine, and explains that a week's ironing can be completed in one-fourth of the time ordinarily required, and at a cost far less than the pay of a laundress for a similar amount of work, and that all this can be done by simply feeding the clothes in the machine. Further, all that is necessary to connect the machine is to screw an ordinary attachment plug in a lamp socket. The ease of installation, without additional wiring, is a point that always appeals to the interested person. Then there is the electrically operated carpet sweeper, the household refrigerating machines, the vacuum cleaning outfit, etc.

Successful campaigns have been conducted in several cities somewhat in the following manner:

An advertisement would appear in the daily and Sunday papers for several days reading somewhat as follows:

"Save time, strength, money, by using modern electrically driven labor-saving appliances. The Citizens' Light, Heat & Power Company requests your presence at its display rooms, No —— ——— Street, Saturday afternoon and evening, Jan. ——, 19——, from 2 until 10:30 p. m. A luncheon will be served, cooked entirely by electricity, and a demonstration of many interesting electrically driven labor-saving appliances for household and other purposes will be given." As printed, the matter, of course, is in display type.

This advertisement would possibly be supplemented by neatly printed invitations mailed to a list of names selected from the city directory.

Such advertising generally brings a large attendance. After partaking of a light luncheon and inspecting the cooking and heating utensils, the visitors are shown the various motor applications, which should be in practical operation, and the advantages explained by courteous and well informed attendants. Attractively executed literature written in a popular style is distributed and everybody is invited to call again.

These little informal receptions often elicit inquiries from manufacturers concerning the merits of electric drive, which lead ultimately to signed contracts. There should, in consequence, be in attendance some representative, well informed on the merits of motor drive, to answer such questions. The exhibition brings the people into closer touch with the central station owners and creates a friendly feeling.

A word as to the personnel of the new business getting department. Men of education and address, preferably those with engineering training and experience in the electrical business should be employed at good salaries, as two or three high-priced men are worth a dozen cheap men. As a further stimulus to activity on the part of the employees, it is good policy to give an additional commission on business exceeding a predetermined amount. The commission system alone does not attract high-grade men as they are nearly always employed at a remunerative salary. Young ladies are frequently very successful in a house-to-house canvass and are often admitted where a man could not secure an interview. In making calls in the residence section, it is always well to have the name of the person one desires to see so as to able to call for him or her and present one's business card. The card should be neat and plain, as a loud or gaudy one presented to a person of refinement will often create a prejudice at the start and seriously impair the prospects for new business.

Upon being admitted the solicitor should state that the call was for the purpose of explaining the workings and advantages of some very useful motor applications for household use.

Business from manufacturing and business concerns should be solicited by attacking the proposition from the manufacturer's standpoint. The manufacturer of mechanical appliances does not care to hear a dissertation of the wonders of electricity and will, undoubtedly, give the solicitor a cold reception unless he is interested at the start by some statement concerning his business. When admitted to the office of the manager or superintendent the solicitor should explain his business and ask if his hearer would be interested in a proposition that would increase the output of his shops without increasing his operating expenses. If so, the solicitor should explain how this might be done by the use of electric motors. If the manufacturer is willing, the solicitor might go through part of his shops, call attention to a belt-driven lathe, for example, and state that by mounting a variable-speed motor directly on the machine the operator will have about five times the increments of speed and that the machine can be started, stopped, reversed and the speed controlled by a handle, conveniently mounted on the tool carriage, without the necessity of leaving the work. The solicitor should call attention to the saving in time required to shift belts and how a wide choice of speeds enables the operator to select one best suited to his work. He should explain that by the use of direct drive shafting and belting are unnecessary, friction losses are eliminated, electrical energy is consumed only when the machines are in operation, etc., etc. By bringing out as many points as possible, the solicitor will at least start the manufacturer thinking, which thinking will in time generally bear fruit.

The value of publicity work cannot be overestimated as the layman and business men in pursuits other than the electrical business do not ordinarily read the electrical papers and are generally ignorant of the progress made from time to time.

Judicious newspaper advertising calling attention to new devices is always worthy of consideration, and is to be recommended. The evening and Sunday papers are the best mediums, as business men and the ladies of the house do not, as a rule, spend enough time reading morning papers to take particular notice of advertisements.

Neat folders mailed with monthly statements frequently arouse interest in some new appliance and lead to an additional load on the house or store circuit. A monthly house organ is oftentimes useful for calling attention to improved devices and keeping the central station in the public eye.

Selling Electrical Energy.

By A. H. Keleher.

As the central station solicitor is the go-between for the central station company and the public, he should be neat in his appearance and be polite in his intercourse with the customer, if the latter is to receive a good impression of the company. Politeness and neatness should be insisted upon. The solicitor can be helpful to the customer in giving him the advantage of his experience in the lighting field, and he is often called upon to advise upon the style of illumination. Therefore, it is advisable for him to be able to discuss the various modern lighting systems and be able to give estimates of the initial and operating cost.

Many letters from customers come to the office of a company daily. Such of these as can be attended to by the solicitor should be turned over to him for action. It will be helpful for him to make a brief note of the contents of each letter, memorandum or postal on a slip of paper, a convenient size being 2½ in. x 5 in. At the top of the slip the address of the customer should be placed, immediately under it being the name. Before starting out each day these slips can be arranged in order, so that the calls can be made by going from one end to the other of the district. Whatever action is taken by the solicitor can be briefly noted on the slip, and can be recorded on his return to the office to report on the business of the day. It is important that the solicitor be out in his district getting business as long as possible each day. About two hours in the office and five in the district is a good division for a seven-hour day. Each solicitor should telephone to the office in the middle of each day, so that the manager may assign to him particularly urgent business in his district. After a little experience the agent will be able to conduct his business with the customer in a very short time, and will not forget some important detail which will necessitate a second visit. In this connection, special care should be taken to secure a correct signature to the contract. If the name of a firm is signed, there should also be added the name and position of the person signing for the firm. Any changes in the ordinary printed contract or any modifying clauses or riders attached thereto should be initialed by the customer.

Contracts are not usually binding upon the central station until accepted by the authorized officer, who is governed by the credit of the customer, the obligation (legal) of the company to furnish energy, and the cost of introducing service into the premises. During the solicitor's visit to the customer's house he will learn whether it is necessary to install a tap from the company's mains. It is next necessary to ascertain whether an extension of the company's existing lines is necessary. For this purpose use can be made of a map showing the streets of the company's territory, with lines drawn in ink showing the mains; if kept up to date by occasional additions, the map will give good satisfaction. After the acceptance of a contract the case should be again placed in the agent's hand. He then orders the service tap installed, if one is required, and arranges for the installation of the meter when the wiring is nearing completion.

Great care should be exercised in selecting a meter of the proper size, as any mistake is sure to react upon the agent and greatly impair his usefulness to the company. Meters should be set in a dry place, easily accessible for testing and reading. In general they should be placed about 8 ft. from the floor, with a clearance of 15 ins. from the center of the meter to any iron construction. The indication of meters set in the vicinity of large masses of iron is utterly unreliable on account of the distortion of the magnetic field. Vibration is equally reprehensible on account of the tendency of the meter to creep. This creeping in some cases increases the cusomer's bills greatly. The standard size for meter boards for Thomson watt-hour meters is 12 in. x 14 in. In selecting the proper sized meter, the following approximate figures, and facts concerning standard illuminants, may be made use of:

It may be assumed that a good meter will, for a short period, withstand a 100 per cent overload. Therefore it is safe in metering the load in detached houses and residences, to use a meter rated box for 50 per cent of the lamps. In places of this kind, very rarely if ever are all the lamps used at the same time. In business houses and apartments the estimate should be 75 per cent. In stores and show-windows, where all of the lamps are used at once, the estimate should be 100 per cent. No fixed rule can be adopted, it being necessary for the agent in many cases to use his judgment, founded upon actual experience. In a three-wire, direct-current system, three-wire meters should be used for 120-volt work except for particularly large installations, where it might be advisable to use two two-wire meters. The meters for a 240-volt motor service should be selected on the basis of three amperes per rated horse-power output. In calculating the number of amperes per lamp on 120-volt lighting circuits, ½ ampere for each 16-cp carbon or graphitized filament lamp may be taken as the proper value. The tantalum 50-watt lamp also takes ½ ampere. The specific consumption of lamps are about as follows: Ordinary 16-cp carbon lamp, 3.2 watts per candle-power; Gem graphitized filament lamp, 2.5 watts per candle-power; tantalum, 1.25 watts per candle-power; and tungsten, 1 watt per candle-power. A safe value for the Nernst lamp is ¾ amp. per glower for the 240-volt lamp. Each glower in a Nernst lamp gives 100 candle-power at a consumption of 88 watts. Nernst lamps for direct-current service are not yet commercially available for 120-volt systems.

A card index system for each central office, showing the progress made on each application for electricity, will be found useful for the immediate information of the solicitors, and for answering queries of the customers as to what has been done concerning their demand for electrical energy. These cards, one lamp and one motor card for each customer, should contain the following data: Name and address of customer, date of receipt of contract, date inspector notified, date accepted, "Service Ordered" (date), "Meter Ordered" (date), and "Connection Ordered" (date), with "Connection Made" and "Installation Connected" (date). On the back of the card may be entered the date of receipt of the City Certificate and the Board of Fire Underwriters' Certificate, which are required before connection can be ordered by the agent.

The use of the follow-up system and an occasional canvass of "Unused Services" will result in new business. Also keeping on good terms with the wiring contractors and getting the names of prospective customers from them will bring about good results. The importance of obtaining sign business cannot be overestimated, on account of the advertising value to the company.

A House Without a Chimney.

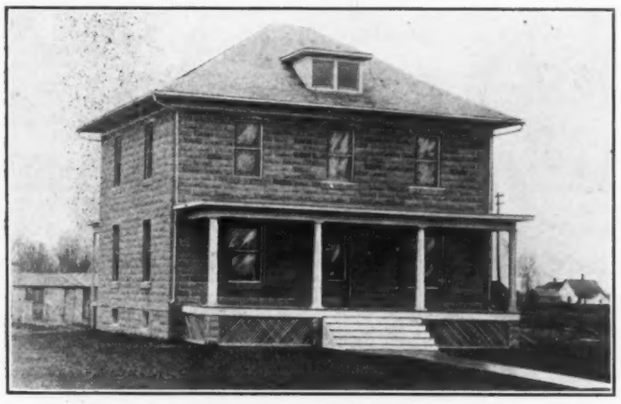
Mr. F. M. Sinsabaugh, secretary and manager of the Carrollton Heat, Light & Power Company, of Carrollton, Ill., has just moved into a new house, which is entirely without a chimney or provision for any kind of fire in the house. Mr. Sinsabaugh is getting heat for warming the house from the company's steam-heating system. Cooking is all done by electricity.

The building of this new house without the chimney marks the beginning of an effort at Carrollton to obtain electric cooking customers. The rates for this business will be five cents per kw-hour. The picture of the exterior of this house without a chimney is reproduced herewith by the courtesy of Mr. Sinsabaugh.

The following quotation from a local Carrollton paper illustrates some of the publicity which the electric service is obtaining by virtue of Mr. Sinsabaugh's unusual house:

"A comfortable, wholly modern residence has been erected in Carrollton without so much as the sign of a chimney, either in or upon it. This is no smoke-consuming joke. The chimneyless house is a fact, but, so far as we can ascertain, it is the only one of its kind in the State of Illinois. F. M. Sinsabaugh is the man who thought he would like to live in a house without a flue. The idea was not entirely original, for many another

man has hopelessly longed for the same thing while putting up the sitting room stove. But the other fellows were not so well fixed to put their wish into execution; Mr. Sinsabaugh is manager of the Carrollton Heat, Light & Power Company. The house will be heated by steam from the company's plant—as are many of the business houses on the square—and the cooking will be done exclusively by electricity. The house combines



CHIMNEYLESS HOUSE AT CARROLLTON, ILL.

more features of the twentieth century home than perhaps any other in Greene County. Its cost will be about $3.500. Mr. Sinsabaugh has expressed, in a practical way, his own faith in the ability of the plant to keep his household comfortable and cook his meals. To build a chimney-less house is the strongest possible expression of confidence."

New Business Campaign in Bayonne, N. J.

By WILLIAM H. STUART.

Bayonne, N. J., a city of some 35,000 inhabitants, is changing from an exclusive suburban town for busy New Yorkers to a city of large manufacturing interests. Being within 20 minutes of New York City, and being surrounded on three sides by the water of New York Bay, Newark Bay and Kill Von Kull River, large industrial interests were quick to see the advantages of Bayonne as a manufacturing center.

The first electric lighting done in Bayonne was in the residential districts. The old Jersey City Electric Light Company was given the right to erect its pole lines and furnish energy in Bayonne in the eighties. Business then was looked after by a solicitor sent from Jersey City. In a short time an agent was sent to Bayonne and an office established, where the few electric appliances of those days were kept on exhibition. Small circulars were occasionally distributed with the monthly bills. These as a rule were not illustrated, but contained notices of the cost of electricity, an enumeration of its advantages and generally some suggestions as to how it could be used.

In Bayonne there are two principal streets, one a business street called Broadway, and the other a residential thoroughfare called Avenue C. It was on these two streets that the greatest amount of business was obtained at first. Bergen Point, the terminal of the trolley lines, is a favorite amusement resort in summer, where swings, photograph galleries, pop-corn stalls, little five-cent shows, etc., abound. There are also five or six large hotels where shore dinners are served. These all use electricity. The hotels extend out over the water, and around the outer edge colored incandescent lamps are arranged, which at night give a very pretty and attractive appearance to the places.

A few years ago a force of six men under the direction of a contract agent went through Bayonne and secured information concerning every house in the city. This information was placed on cards and filed at the office. All reports showing the necessity of a prompt return call were set aside and the matter given immediate attention. After this canvass a systematic record was kept of the territory. The cards upon which the original information obtained was placed contained the street and number, occupant's name, name of owner of property, the illuminant used, reasons for not using electricity, what kind of sign or outside lighting, if any, and notes as to whether electric signs or arcs could be used. On the reverse side of the card a space was allotted to the wants of the prospective customer. This canvass brought good results in that it reached a great many places that had not been touched in the regular work.

About the time this canvass was completed and placed on record, Bayonne's industries started to grow. Along the waterfront, factories ranging in size from the immense Standard Oil plant to a small machine shop have taken the place of the country houses. The new business methods of the Public Service Corporation, which now supplies Bayonne with electricity, have kept pace with the various changes which have occurred from time to time.

Speaking of what has been accomplished, the methods employed and the many obstacles encountered in building up the electrical business in Bayonne, Mr. Charles H. Randall, the agent, said: "In early days we had considerable trouble in convincing people of Bayonne of the uses of electricity and offsetting the feeling of costliness associated with it. Most of our business consisted of residence lighting, although we supplied a great many of the stores with electricity also. We have advertised consistently. Our monthly bulletin, *Light and Power*, is mailed to all interested in electricity. This bulletin contains quite a number of cuts and short notices of various installations which show just what is being done. The bulletin has been favorably commented upon by a great many of our customers. Each month we have printed on the back of our bills some interesting facts which are oftentimes illustrated and are always in season. During the summer, blower fans, etc., would be talked about, and in the fall and winter electric lamps, etc., would receive attention. Every now and then pasters are attached to the bills. These are used for the purpose of directing the consumer's attention to something special—something that would be of advantage to him, such as emphasizing the necessity of renewing dim lamps. We have placed a great many flatirons out on trial and we have been successful in selling a great majority of them. We have found that a trial absolutely convinces where a talk might sometimes be doubtful. We furnish electric signs of the panel type free of charge and have quite a number throughout the city. In our office we have a complete line of heating and cooking devices which are sold at cost. These are arranged for easy demonstration and as our office is close to the center of the city we have quite a number of inquiries concerning them.

"A few years ago the character of our business began to change. The large industries coming to Bayonne brought with them numerous workmen, so that where we formerly had a few large stores catering to the wants of the people we now have a great many small ones scattered throughout the city. The owners of small stores were at first a little afraid of installing electric lamps, but after one or two had started, it was not long before the majority were using electricity. The factories had to have both lamps and motors and we were kept busy for a time meeting this new demand. We have been favored with a large share of this business. Combined with our show or summer amusement load this gives us a very even load throughout the year. During the winter months the numerous amusements at Bergen Point are closed and the factories use considerable energy. During the summer months the factory load is quite light and the amusement load heavy. During the past year we have equipped two new theaters with some 3500 lamps and an amusement park with about 40,000 lamps. All of these installations we consider very good advertising for electricity.

"In our search for new business we have encountered many hard problems which had to be overcome, such as asking for the business of a large industry operating about 18 to 20 hours every day. Satisfactory arrangements have been made whereby

we have secured the business. Bayonne as a manufacturing city has only started to grow. We are aware of this fact and are on the growing move ourselves."

The present methods of obtaining new business are proving entirely satisfactory. Additional lighting is solicited by one man, and the motor load is looked after by an expert power solicitor. These men canvass the city thoroughly, keeping a record of the business on a card. The latter is kept up to date and is used for reference. The architects are visited frequently and are in thorough accord with the company. A special effort is made to render every aid that an architect may require. There have been one or two cases where electrical points have arisen when the architect was engaged in the preparation of plans, on which the company rendered assistance. New building contracts and real estate matters published in the newspapers are closely followed up, and much business has been secured by this means.

Sign Lighting in Scranton, Pa.

As is probably well known, the electric lighting plants in Scranton, Pa., formerly controlled by the Electric Company of America, have recently been acquired by the American Gas & Electric Company, of which Mr. Henry L. Doherty is president. Early in February, 1907, the new management inaugurated a sign campaign, and as a result of this campaign, 240 customers were connected to the sign and outlining display midnight service. The accompanying illustration shows the

NIGHT VIEW OF A SCRANTON STREET.

sign lighting on Lackawanna Avenue, one of the principal thoroughfares of Scranton. Some of the department stores on this avenue have for many years kept their windows lighted at night, but the number of signs on this avenue was until recently very small. Scranton is a very busy city, in the heart of the anthracite coal region, and the results obtained by the Scranton Electric Company in its sign campaign shows how readily electric signs may be connected to the lighting circuits when their advantages are properly presented. Despite its size, Scranton is not a very rich city, the wealth per capita probably being smaller than that of many other cities of its size.

Janesville Electric Company Offices at Night.

By the courtesy of Mr. P. H. Korst, manager of the Janesville Electric Company, Janesville, Wis., we are enabled to reproduce the accompanying striking illustration showing the appearance at night of one side of the building which houses the offices of the Janesville Electric Company. This building adjoins the Rock River, from which the company gets part of its power, and the illuminated sign which has been painted on the side of the building is on the side next to the river, so that it is in a very conspicuous place. The offices front on the main street, and everyone crossing the bridge going toward the offices cannot fail to see the illuminated sign. The location of the sign makes especially appropriate the phrase, "The Power of Rock River at Rock Bottom Price."

ILLUMINATED SIGN, JANESVILLE, WIS.

Letter to the Editors.

Cords and Chains for Electric Light Fixtures.

To the Editors of Electrical World:

Sirs:—It has frequently been said by those interested in electric lighting that electric fixture designs have followed too closely the lines of gas fixtures. There is undoubtedly much truth in this assertion. Because a gas fixture needs a pipe to convey gas to its burners is no reason why the electric man should persistently use a rigid pipe for his fixtures also. In the abolishment of the conventional gas fixture idea, electric fixture designers will have the hearty support of architects, who are apt to consider the lighting fixture as somewhat of a nuisance. To these, electric lighting should appeal particularly for the reason that it offers the opportunity of doing away with fixtures altogether by placing lamps in recesses with suitable reflectors behind them or the use of unobtrusive hemispheres. This applies mainly, however, to the more expensive work. For cheap, every-day installations, more extensive use of cords and chains can be made with advantage than has been common practice in the past. Unfortunately, the plain drop cord has received the stamp of cheapness and inelegance, largely because of the cheap, quickly fading cord that has commonly been used and the way it has been used. Certainly, some of the round silk-covered cord now easily obtainable in the open market is no more unsightly than the brass rods which it might in many cases supplant. There is no reason why it should not be more generally used to support light lamp fixtures of most artistic design. For heavier fixtures which it is not permissible to hang from cords, the chain pendant offers a cheap, artistic and substantial solution.

Both chain pendant and drop cord offer a better mechanical construction in many places than a fixture with a rigid stem. Very few fixtures remain in use many years without becoming more or less loose at the ceiling. They are exceedingly likely to get out of plumb, and are frequently pulled one way or the other by having extension plugs and cords attached to them. The flexible suspension, which keeps itself in plumb and yields to accidental blows instead of breaking, is much more desirable than a rigid stem. At the present time, it is by no means necessary, for artistic reasons, for a prospective electric light customer to spend an enormous amount of money in fixtures. In fact, it is possible to do a large amount of high-grade work with a very small fixture bill. The old idea of fixtures with a large number of arms, each carrying a small lamp, is rapidly disappearing, except for the comparatively few locations where the decorative effect of a large number of small lamps is wanted. A fixture with several arms also finds a very useful place in rooms where the difference of requirements at differ-

ent times makes several sockets necessary. But for most purposes of general illumination, the simple fixture with a few lamps, or with possibly but one, and of high candle-power is taking the place of the fixture with the centipedal effect and here is where the cord and chain are suitable.

NEW YORK. CHAS. T. ALTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Direct-Current Machines.—T. ROSSKOPF.—A mathematical article on the best utilization of the armature of a direct-current machine. In the choice of the magnetic flux density and electric current density one is limited by commutation and heating. The limitation as to commutation has now been practically removed by the use of interpoles. The author, therefore, considers only the limitation due to heating. The degree of utilizing the armature is defined as the value $\frac{D^2ln}{P}$ where D is the armature diameter, l the "ideal" armature length, n the speed and P the power in kilowatts. This value is called the "dimension constant." The author first considers the case of an armature with very large diameter and gives formulas for calculating the most economical value of amperes per square centimeter, etc. From a numerical example he finds agreement between his formulas and best modern practice. In the second part of the article the case of an armature with a smaller diameter is discussed and illustrated by a numerical example.—*Elek. und Masch.*, Jan. 5.

Ball Bearings for Electric Motors.—An article in which the advantages of the use of ball bearings on electric motors are discussed under the following headings: Decreased length of machine, no wear on bearings, no oil in bearings, less starting resistance, and increased efficiency. As disadvantages, the writer mentions increased cost and the fact that the ordinary ball bearings will not take up end thrust. Of the different kinds of ball bearings those in which the balls are kept apart by being placed in a thin ring or cage with holes to suit the size and number of balls, is considered to be the best one. The mechanical construction where ball bearings are used on motors are described and illustrated.—Lond. *Elec. Review*, Jan. 10.

Coil-Winding Machine.—An illustrated description of a coil-winding machine devised by W. Cramp, and intended to dispense with the large number of formers now necessary for winding small coils. Being adjustable in all its dimensions, independently of one another, it enables almost any size or shape of hexagonal coil to be wound for a range of machines from ¼ kilowatt upwards to 15 kilowatts.—Lond. *Electrical Engineer*, Dec. 20.

Winding Devices.—A brief illustrated description of various devices which have been developed in the winding room of the shops of the West Penn Railways for decreasing the cost of armature and field coils. Among the devices are a hot-coil press, coil clamp, insulation cabinet, commutator slotter, field-coil tester, and a baking oven.—*St. R'y Jour.*, Jan. 10.

Lamps and Lighting.

Photometry.—The very long committee report presented to the American Gas Institute at the last Washington meeting on methods of measuring the candle-power of gas lamps is printed in full. It is urged that there should be a national, or, even better, an international unit of intensity of light. The Bureau of Standards could then furnish to the testing laboratories throughout the United States electric incandescent lamps certified to concerning their value in terms of the unit agreed upon. At present the electrical people and the gas people use differ- unit of candle-power equals 100 ÷ 88 of the hefner unit under Reichsanstalt standard condition for the hefner." On the other hand, the International Incandescent Photometric Commission appointed at the time of the World's Fair, at Paris, met in Zürich in 1903, and formulated plans for a separate determinaent units. The American Institute of Electrical Engineers has the following rule: "The luminous intensity of sources of light is expressed in candle-power. The unit of candle-power should be derived from the standard maintained at the National Bureau of Standards, at Washington, D. C., which standard tion in England, France and Germany of the ratios existing between the Hefner, the Carcel and the Harcourt pentane lamp. At their meeting in 1907 the ratio of the intensity of the Hefner lamp to that of the Harcourt was declared to be, Harcourt pentane = 10.95 hefners. The English Institute of Gas Engineers and the English Engineering Standards Committee declare that the English candle equals one-tenth of the Harcourt pentane lamp, or 1.095 hefner. The American Institute of Electrical Engineers have adopted the German relation of the hefner to the candle in which the candle equals 1.14 hefner. In other words, the unit of light adopted by the American Institute of Electrical Engineers is 4.1 per cent greater than the unit of light adopted by the English Institute of Gas Engineers. In the long discussion which followed, Dr. Hyde referred to this discrepancy in the definition of candle. Both of the different candles purport to be English Parliamentary candles. He made a suggestion that "if the gas industry is willing to come up about 2 per cent in their candle, and the electrical industry is willing to drop about 2 per cent in theirs, we will meet on a common ground."—*Progressive Age*, Jan. 1.

Arc-Lamp Photometry.—An illustrated description of the photometer equipment of a large arc-lamp factory in Germany. There are two rooms, one with black walls and the other with white walls. In the former the candle-power is determined and polar curves are plotted. Three photometers are used, a "polar mirror photometer," a "diagonal photometer," and the Ulbricht spherical photometer. Current and voltage curves with alternating current are determined by oscillographic means. In the same room the color differences of different lamps are determined by a spectrometric method. In the other room, with white walls, the illumination at different points of the floor with direct and indirect illumination is determined.—*Elek. Zeit.*, Jan. 2.

Direct and Indirect Illumination.—An article in which it is pointed out that while in certain cases indirect illumination is of great value, as in draughting rooms, reception rooms and schools, it is not necessary in by far the most cases, and is not to be recommended as it is quite an expensive method. An analysis of the losses in indirect illumination is given.—*Zeit. f. Beleucht.*, Dec. 30.

Power.

Electric Energy Supply—W. B. WOODHOUSE.—A paper read before the Leeds section of the (British) Institution of Electrical Engineers on the commercial aspect of electric energy supply. The author deals with the advantages of centralization of electric supply and gives figures showing the saving in capital expenditure and works cost by such centralization. He also discusses the production of electric energy by utilizing the gases from blast furnaces, coke ovens, etc., and shows the need of co-operation of the users of waste heat, the motor users and the supply companies. Concerning equalizing the station load by employing at times of low load the energy for electro-chemical purposes, he mentions that he has recently arranged an agreement on such lines for a British supply company with a company making calcium carbide in an electric furnace. "The improved conditions under which the station will operate should show a considerable decrease in the average cost of production."—Lond. *Elec.*, Dec. 27.

Steam-Pipe Systems for Generating Stations.—J. H. RIDER.—

A long illustrated article in which the author emphasizes that a properly designed and constructed steam-pipe system is not only perfectly safe, but will give no trouble in working. Simplicity, however, is the keynote of success. The main principles underlying a good steam-pipe system are as follows: The pipes should be as short and as few as possible. The failure of any pipe should affect only one engine or one boiler (or group of boilers). The pipes should be as small in diameter as possible, to reduce the radiation losses. The pipes should be large enough to keep at minimum the fall of pressure between the boilers and engines. The joints should be as few as possible. Proper provision must be made for water drainage, also for expansion and contraction, and for cutting off various sections in cases of emergency. These different principles are discussed in detail.—Lond. *Elec. Eng'ing*, Dec. 19.

Traction.

Single-Phase Road.—E. Engelmann.—An illustrated paper on the electric equipment of the Mariazell Railroad. On account of greatly increased traffic on this steam road it has become necessary either to build a second track, which would be too expensive on account of the great natural difficulties, or to increase the speed. An increase of speed would have been impossible with steam traction, and under these circumstances it has been decided to introduce electric traction. It is possible that the line will later on be carried further into Vienna. Comparisons were made between different electrical systems, and it was found that the watt-hour consumption on level road per ton kilometer varied between 31 and 40. Under the conditions of this road, the single-phase system was found to be the best one on account of low first cost and low cost of maintaining the single overhead wire. Further saving became possible by utilizing available waterfalls. There will be in the whole three stations, of which two are hydraulic, while a third one, which acts as reserve, and is in operation only for two or three months in the year, is operated by Diesel engines. The first development will be for 5000 hp, the transmission voltage 25,000 and the voltage on the trolley wire 6000. There will be used 17 four-axle electric double locomotives, each locomotive being equipped with two 200-hp single-phase motors, and two oil-transformers for reducing the voltage from 6000 to 150 or 300. All axles are driving axles. The weight of the completely equipped locomotives will be 30 tons.—*Elek. und Masch.*, Jan. 5.

Heavy Electric Locomotives.—B. Valatin.—An article on large electric locomotives for heavy service. The author gives a comparison of a 15-cycle single-phase locomotive and a 15-cycle three-phase locomotive in weight and performance. He claims that the weight of the three-phase locomotive is only one-half that of the single-phase locomotive. *St. R'y Jour.*, Jan. 4.

One Thousand Five Hundred-Volt Direct-Current Railway.—An illustrated description of the Bellinzona-Mesocco Railroad in the Misoxer Valley, in upper Italy, which has already been noticed in the Digest from a German source.—Lond. *Elec. Eng'ing*, Jan. 9.

One Thousand Two Hundred-Volt Direct-Current Line.—J. R. Hewett.—An illustrated description of the railway system now connecting Seymour and Sellersburg, Ind., a distance of 41 miles, but finally to extend from Louisville, Ky., to Indianapolis, Ind., the distance being 110 miles. The novel features of the 1200-volt direct-current apparatus are described in detail.—*St. R'y Jour.*, Jan. 4.

Surface-Contact System.—J. T. Morris.—An illustrated paper on the "G. B." (Griffiths-Bedell) surface-contact system which is to be used on an experimental section in London. The same system has been working satisfactorily for considerable time on a line about 3 miles in length in Lincoln. A magnetized skate, attached to the car by insulating bolts, slides over a series of iron studs in the roadway along the center of the track. The skate magnetizes the stud and actuates a switch connecting the stud to a live conductor beneath it, and thus energy is supplied to the car. Immediately the skate leaves the stud, the switch automatically opens. The skate employed in the G. B. system is flexible, and in consequence allows the studs to be level with the road surface. It is made up of iron links strung on a flexible cable and supported by vertical springs in a slot running along one pole of an electromagnet. Normally the skate is 2 ins. above the road surface, but any part that is over a stud is attracted down and makes contact with it. The magnet consists of two long poles, one above the other, connected by three yokes, on which the coils are wound. The skate is attached to the lower pole. The coils are supplied with energy from the underground conductor, and a battery is provided for use when the car is standing still. The construction of the stud is as follows: From the cast-iron plate in the surface two soft-iron prongs, or cheeks, project downwards. Between these the plunger or switch-piece is supported by a vertical spring. When the stud is magnetized, the plunger is forced out from between the cheeks and a carbon block at the lower end makes contact with the underground conductor. Electricity then flows from the conductor up through the plunger by flexible leads to the stud, and thus to the car. The spring is insulated and does not carry current. It is also heavily plated to protect it against rust. If ordinary rails were used at points and crossings, the skate would be atracted to the rail as well as to the studs, and would short-circuit the 500-volt supply system. To prevent this result manganese steel is used at such positions. This steel, which consists of 88 parts of iron and 12 parts of manganeee, is practically non-magnetic. Further protection is provided in a special kind of stud.—Lond. *Elec. Engineer*, Jan. 3.

Trolley-Wire Suspension.—A detailed illustrated description of the Pringle "tangential" trolley-wire suspension.—Lond. *Electrical Eng'ing*, Jan. 9.

Gasoline-Electric Omnibus.—An illustrated description of the Hart-Durtnall gasoline-electric motor omnibus. It contains a gasoline engine and a three-phase generator with small exciter and an induction motor with squirrel-cage rotor. There is also a magnetic clutch by means of which at the highest speed the driving shaft is clutched solidly with the engine shaft. At lower speeds part of the power of the engine is transmitted mechanically by means of the clutch and part electrically.—Lond. *Elec. Engineering*, Jan. 3.

Installations, Systems and Appliances.

Protective Relays.—M. C. Rypinski.—The first part of an illustrated article on protective relays used in conjunction with automatic circuit-breakers for the protection of circuits from abnormal and dangerous conditions, such as overload, short-circuit, reversal of circuits, etc. After some general remarks, the author gives a classification of the standard types of protective relays, and then discusses briefly the protection of alternating-current circuits and more in detail direct-current over-voltage relays. The standard types of protective relays include direct-current over-voltage instantaneous, reverse-power instantaneous and inverse-time-element relays, alternating-current overload instantaneous, inverse-time-element and definite-time-limit relays, and alternating current overload and reverse-power inverse-time-element relays.—*Electric Journal*, January.

Wires, Wiring and Conduits.

Slide Rule.—An illustrated description of a new slide rule made by a British company for rapidly determining the sectional area of a cable for use under given conditions. "The instrument consists of a rectangular block of cardboard, on which move two vertical slides and two horizontal slides. The horizontal slides are divided in yards, volts and kilowatts, and the vertical slides in values of power factor and per cent of loss. The rest of the block is covered with a series of curves connecting load in kilowatts and loss per cent in volts, for sections of conductors up to 6.5 sq. ins. The slide rule is readily adapted for use with any system of supply, continuous current or alternating.—Lond. *Electrical Engineer*, Dec. 27.

Cable Making.—An illustrated description of various machines used in a British cable factory.—Lond. *Electrical Review*, Jan. 10.

Graded Cables.—A full account of the fundamental patents for "grading" cables. These are an Italian patent by Piralli &

Company, of 1900, and two British patents of M. O'Gorman, of 1901.—Lond. *Elec. Eng'ing*, Jan. 9.

Enamel Insulation.—A description of a new enamel insulation of British make for which many advantages are claimed. It is said to be flexible, tough and elastic, waterproof and a good insulator, unaffected by ordinary chemicals or exposure to air. Three coatings of enamel are used on ordinary wires which altogether add less than one-thousandth of an inch to the diameter of the bare wire, and it is said that finer coating for special purposes can be applied. A modification of this enamel insulation is used when it is intended to be oil-proof, but this is not as flexible.—Lond. *Electrical Engineer*, Dec. 20.

Electrophysics and Magnetism.

Temperature-Resistivity Coefficient of Alloys.—W. GUERTLER.—A long paper on the formulas of Matthiessen and Barus for the temperature-resistivity coefficient of metallic alloys. It is shown that the Matthiessen rule is the only general one, while that of Barus is valid only under special conditions.—*Phys. Zeitschrift*, Jan. 1.

Electrochemistry and Batteries.

Electro-Analysis.—F. FOERSTER.—A review of recent progress in electro-analysis, especially in the use of strong circulation of the electrolyte by means of rotating electrodes, etc. The author thinks that the time has come to work out with greater accuracy methods not using such circulation.—*Zeit. f. Elek.*, Jan. 3.

Units, Measurements and Instruments.

Voltmeter Compensation.—W. NESBIT.—An illustrated article in which the author describes the method of adjusting a voltmeter compensation for alternating-current feed circuits so that the station voltmeter will read directly the correct e. m. f. at the distant load. Fig. 1 is a diagram of the compensator. It shows secondary windings giving 24 resistance and 24 reactance volts compensation with 5 amperes in the circuit. *C* is a potential transformer delivering at its secondary an e. m. f. proportional to and in time-phase with the station e. m. f. *S* is a series transformer producing in its secondary circuit a current proportional to and in time-phase with the main-line current. *A* is a non-inductive resistor, and *B* is a reactance coil. *A* and *B* are connected in series, and through them passes the current from the secondary of *S*. The e. m. f. between the terminals of *A* is, therefore, always in time-phase with the back e. m. f. due to resistance of line, while that between the terminals of *B* is in time-phase with the back e. m. f. due to reactance on the line. *D* is a transformer connected in shunt to *A* and yielding at its secondary terminals an e. m. f. in time-phase with and proportional to that across *A*. *B* has a secondary winding on it, so that it fulfills the double function of a reactance coil and a transformer, thus insulating the voltmeter circuit from the feeder. Both *B* and *D* are provided with ten leads, which are carried out to switch contacts, permitting the resistance and reactance volts introduced into the voltmeter circuit to be varied at will. With the proper amount of resistance and reactance volts introduced into the voltmeter circuit, the desired result is obtained, since there is from *C* an e. m. f. proportional to and in time-phase with that of the generator, and from *D* and *B* e. m. f.'s in time-phase with and proportional to the back e. m. f.'s due to resistance and reactance of the feeder circuit. The e. m. f.'s from *D* and *B* diminish the e. m. f. from *C* in exactly the same way and by exactly the same percentage as the back e. m. f.'s in the main line diminish the voltage from the station. The voltmeter will, therefore, always give an indication proportional to the voltage delivered to the load. The switch levers should be set so that at the rated current of the series transformers, which is connected to the compensators, the resistor and reactance coil in the voltmeter circuit will be equivalent to those of the line. Since both the resistance and reactance voltage of the compensator is exactly proportional to the current (the same as in the line itself) the compensator, when set for the same resistance and reactance volts as that of the line at the rating of the compensator series transformer, will furnish the proper compensation under all conditions of load and power-factor. It is in general difficult to calculate the amount of resistance and reactance in the circuit for which the compensation is intended, but it is not difficult to adjust the compensator by trial. Telephonic communication should be established between the station and the point at which the voltage is to be kept constant. When the load having the highest power-factor is being carried by the feeder (this will usually be at maximum load), the station e. m. f. should be adjusted until the proper voltage is being delivered to the load. At this time the switches on the resistance and reactance sides of the compensator should be set on points which will give the same reading on the compensated voltmeter as does the voltmeter at the load, the switches on the resistance and reactance sides being set at similarly numbered points. This setting would then be correct for all loads if the power-factor did not change. The power-factor will probably decrease as the load becomes less, and if at loads of lower power-factor the compensating voltmeter indicates a higher voltage than that at the load, not enough reactance is in the voltmeter circuit, and, hence, it will be necessary to increase the reactance until the two voltmeters read alike. If at loads of less power-factor the compensating voltmeter indicates a lower voltage than that at the load, too much reactance is in the voltmeter circuit, and it will be necessary to cut some of it out until the two voltmeters read alike. The above adjustment should preferably be made at the maximum and minimum power-factors. A new comparison of the voltmeters is then again made at maximum power-factor and if there is discrepancy, adjustment is made on the resistance side, and so on. It is sufficient to remember that all the adjustments should be made on the resistance side for high power-factors and all the adjustments on the reactance side for low power-factors.—*Electric Journal*, January.

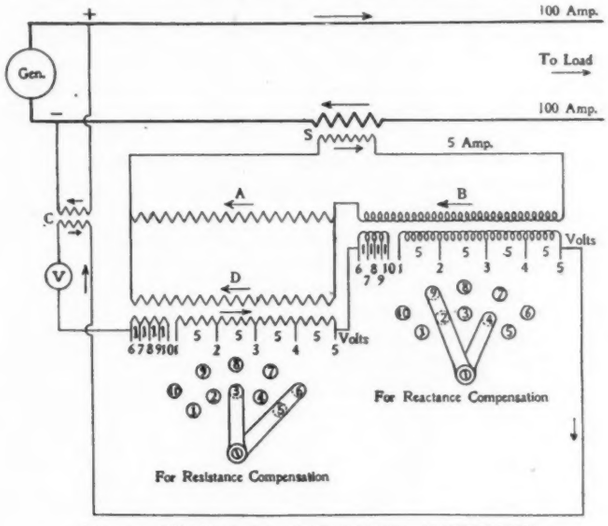


FIG. 1.—DIAGRAM OF COMPENSATOR CONNECTIONS.

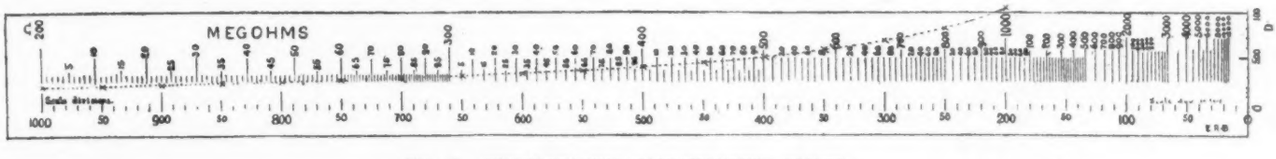


FIG. 2.—DIRECT-READING GALVANOMETER SCALES.

Direct-Reading Galvanometer Scales.—J. RYMER-JONES.—A description of a method which saves much time and calculation when the "dialectric resistances" of a number of condensers,

or insulated wires, have to be measured. Of the two parallel scales, shown in Fig. 2, the lower one is divided into 1000 equal divisions, while the upper *DR* scale is so graduated that its insulation valves are in inverse proportion to the divisions on the lower scale. If, therefore, the testing galvanometer be shunted to make the testing battery through one megohm give the full deflection of 1000 divisions, and if this deflection is, moreover, made to coincide with the one-megohm graduation on the upper scale, then deflections of 500, 250 and 125 divisions should coincide respectively with 2, 4 and 8 megohms; and there should be a similar coincidence between all intermediate deflections and their corresponding *DR* values. The disc of light, with its fine dark line as an index, is reflected from the mirror galvanometer between these two scales, either of which may therefore be equally well used as desired. As the universal shunt is not always sufficiently subdivided to give exactly the full scale deflection of 1000 divisions with the testing battery through one megohm, the multiplying power (*mp*) of the slide reading (*sr*) required to give 1000 divisions is obtained by inverse proportion from the deflection (*d*) observed with a suitable slide reading having a multiplying power *MP;* that is, $mp = MP\frac{d}{1000}$, and its $sr = \frac{10{,}000{,}000}{MP \times d}$. Or if, when employing a universal shunt of 10,000 sub-divisions, a slide reading of 10, having a *MP* of 1000, be used, the formula can be simplified by making $mp = d$, for which the $sr = \frac{10{,}000}{d}$.

Although the insulation values of a set of condensers, or insulated wires, made under the same conditions generally agree closely, and can therefore be tested with the same scale, the *DR* of other sets will differ greatly according to capacity, resistivity or temperature; consequently several galvanometer scales with widely different ranges are required. The principle of graduating the upper scale is, however, the same; but instead of the lowest insulation value (*R1*), which always coincides with the 1000 divisions, being only one megohm, as assumed above for the purpose of explanation, it will vary according to the requirements, and the slide reading (*sr*) used for each scale must be in direct proportion to *R1*. Numerical examples are given and methods of finding the resistivity-temperature coefficient and of graduating the *DR* scale are described.—Lond. *Electrical Review,* Jan. 10.

Alternator Test.—T. Fraser.—In a recent test of a 1250-kilovolt-ampere turbo-alternator under full load at 80 per cent power-factor, the following method of obtaining the desired inductive load was used. At the place of the test the permanent loading arrangement consists of a large water resistor which gives a non-inductive load. To obtain 80 per cent power-factor, an auxiliary alternator was used, a duplicate of the one under test. The machine was run light as a synchronous motor from the alternator circuit, and its field was gradually weakened until the required power-factor was obtained. As it was not convenient to run up to speed and synchronize the auxiliary machine, it was started as an induction motor.

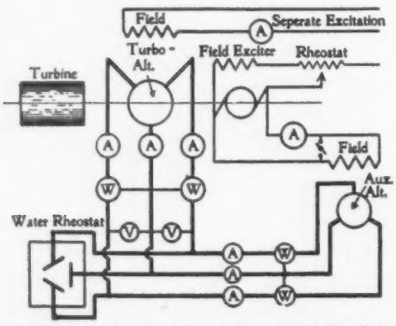


FIG. 3.—DIAGRAM OF CONNECTIONS FOR TEST OF ALTERNATOR.

From the diagram of connections shown in Fig. 3 it may be seen that the stators of the two machines were electrically connected, the field of the generator separately excited, and the field coils of the motor short-circuited during starting. It was, of course, necessary to excite the generator field from an independently-driven exciter, as otherwise no voltage could be obtained until the machine reached a considerable speed. The turbine was started, and as soon as sufficient speed was obtained (about 20 r. p. m.), the motor started up. When the motor reached full speed, the field circuit was opened and the field excited. Another method of starting was also tried. This was the same as the one already explained, with the exception of the field circuit connections. Instead of being short-circuited, the field coils were connected directly across the armature of the shunt exciter, the exciter being coupled to the turbine. The field flux built up gradually, as the turbine's speed increased, the two machines running in synchrononism at all speeds. Absolutely no trouble was experienced with either method, and the power-factor could be adjusted to a nicety.—*Electrical Journal,* January.

Measuring the Damping in Electric Oscillation Circuits.—K. E. F. Schmidt.—The most reliable method for measuring the damping of an electric oscillation is based on the use of a very loosely coupled condenser circuit, the characteristic damping of which is brought to a minimum and the capacity of which can be adjusted. If then a resonance curve is plotted, formulas of Bjernas and Drude permit in a very simple way to find the logarithmic decrement from the curve. However, according to these formulas the curves should be symmetrical while in reality they are not. The author discusses some inaccuracies in the old theory and shows that while the theory is somewhat more complicated yet the desired logarithmic decrement can be very easily found from the resonance curve.—*Phys. Zeitschrift,* Jan. 1.

Roentgen Ray Apparatus.—An illustrated article on recent progress in the construction of Roentgen-ray apparatus. One of the most important advances is the use of tantalum in place of platinum for forming the anti-cathode of the Roentgen-ray tube. Several forms of radiometers, etc., are described, as well as a portable Roentgen-ray apparatus for ambulance service used by the military authorities in several European countries.—Lond. *Electrician,* Dec. 27.

Telegraphy, Telephony and Signals.

Efficiency of a Telephone.—F. H. Abraham and D. Charbonnel.—A paper giving some instructions concerning the most efficient arrangement of telephone lines. For a given sound, the microphone behaves as an alternator without inductance, having an internal resistance of about 10 ohms. If the line is very long, it may be regarded as a resistance *R,* of the order of 500 ohms, in series with a capacity *C* of a fraction of a microfarad. At the receiver, the line acts as an alternator, having these same characteristic constants, *R* and *C,* and an e. m. f. amounting to a definite fraction of the e. m. f. supplied. These assumptions may be made the basis of a complete theory of the transmission of a musical note along a very long telephone line. The authors specify the conditions which make for the loudest rendering. For every type of receiver the diameter of the wire must be such that the resistance of each of the two receivers shall be a little higher than one-quarter of the apparent line resistance *R.* In practice, this means choosing receivers with a resistance of about 100 ohms. If *M* is the internal resistance of the microphone, the most favorable transforming ratio is a little higher than $R \div 2M$. In practice this means a transforming ratio of 6 to 7. The impedance of the thin wire of the transformer must be decidedly greater than the apparent line resistance *R.* The above conditions are usually observed in good commercial circuits. As regards the efficiency of commercial telephone transformers, the authors find that to be less than 60 per cent. An efficiency of 90 per cent should be easily attainable without making the transformers too costly or too cumbrous. The authors give the following dimensions as a model: Length, 17 cm; external diameter, 3 cm; total section of iron wires, 0.3 sq. cm; turns of thick wire 550; turns of thin wire, 3300; diameter of thick wire, 1.1 mm; diameter of thin wire, 0.4 mm; resistance of thick wire, 0.9 ohm; resistance of thin wire, 24 ohms; and inductance of the same, 0.4 henry. Too much must not, however,

be expected from this improvement, as the ear is not very sensitive to loudness, an increase of 50 per cent being barely distinguishable. The improvement of the microphone offers a much more promising field, and the authors believe that all existing types are capable of great improvement.—*Comptes Rendus,* Dec. 23; Lond. *Elec. Eng'ing,* Jan. 9.

Telephone Exchange.—An illustrated description of the new trunk telephone exchange in Bradford, England. The exchange embodies all the most recent devices for facilitating the utmost utilization of the trunk lines without waste of time. The description includes details of the arrangement by which a telegraph circuit is superposed on the lines for the purpose of transmitting all service directions, so that the telephone circuit is used for remunerative conversations only, and it also contains a description of the time check which has been evolved by the postoffice for assisting the operator in controlling the duration of a conversation by giving a lamp signal when the three minutes have expired.—Lond. *Elec. Eng'ing,* Jan. 9.

Selective Ringing Up.—R. HEILBRUM.—A description of a simple device for ringing up one single station in a line which contains several stations. The device is essentially a hot-wire instrument. The hot wire is arranged in air within the upper closed part of one leg of an inverted U-tube, the tube being sealed at the bottom by some liquid. When the ordinary telegraph currents pass through the hot wire the expansion of the air is not sufficient to displace the liquid at the bottom materially. It is only when a continuous current exists for several seconds in the hot wire that the air expands sufficiently to make the liquid rise in the other leg to such a height that a local circuit is closed and the bell rings.—*Elek. Zeit.,* Jan. 2.

Photographing at a Distance.—A description of an apparatus suggested by S. Sivelli for the purpose of reproducing at a distance the optical image of a photographic objective. The sending apparatus consists of an ordinary photographic camera, the sensitive plate of which is replaced by a plate made up of a network of small selenium cells, insulated from one another and communicating with a constant source of electricity, the negative terminal of which is connected to earth. From each of these selenium cells there starts an insulated wire, dipping into a small mercury vessel arranged on a horizontal plane. There are thus as many mercury vessels as there are selenium cells. These vessels are arranged round the circumference of a circle, round the center of which rotates a metal index operated by clockwork, which, with a point attached to its end, will come into contact successively with each of the mercury vessels. This index communicates with a wire connected to the receiving apparatus, and insulated from the remainder of the outfit. The apparatus is to be worked in the following manner: After adjusting the focus for the image to be reproduced, the circuit is closed and the index having been set working, will traverse one after another, the mercury vessels corresponding to the respective selenium cells. The electric current from the battery will traverse the selenium cell actually in communication with the metal index, and according to the more or less considerable action of the illumination on the cell, will undergo a more or less considerable alteration in intensity. These alterations in current intensity, corresponding to the illumination of each of the selenium cells, are thus successively transmitted to the receiving station, there to be reconverted into variable light intensities. The receiving apparatus may be of various kinds; the one suggested by Sivelli is based on the following principle: a cylinder performing a translation and a rotation is surrounded by a sheet of white paper, at a short distance from which a style communicating with an electro-magnet is arranged. If everything be adjusted in order to eliminate any variation of current intensity as long as the luminous intensity in all the selenium cells is the same, each current closure will result in the production of a dash of more or less intensity, according as the selenium has been acted upon more or less strongly. The sheet of paper will thus be covered with a set of dashes reproducing with greater or less approximation the optical image by the photographic objective. The method thus outlined is obviously a purely hypothetical one. To produce an image at the receiving end that shall be coherent enough to be intelligible, the number of cells would have to be at least 1000 to the square inch; and unless vastly more sensitive means than selenium cells can be devised for converting the variations of light intensity into variations of current strength, the idea seems impossible of realization.—Abstracted from *L'Elettricita* in Lond. *Elec. Review,* Jan. 10.

Miscellaneous.

Measuring Area.—At a recent exhibition of the British Physical Society a new form of area scale was shown, which is illustrated in Fig. 4. It is made of celluloid and intended for the

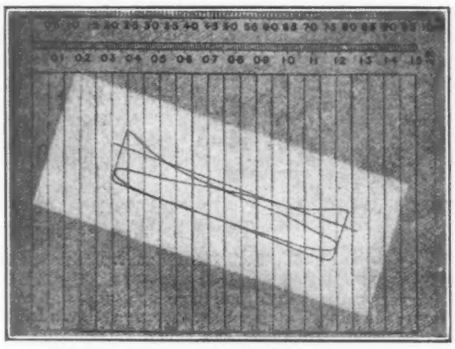


FIG. 4.—MEASURING AREA.

rapid measurement of the area of any figure, it being, of course, particularly suitable for obtaining areas of indicator diagrams. The scale is placed over the figure, the area of which is to be obtained, so that the ends of the figure lie equidistant between two of the vertical lines on the scale. A strip of paper is then placed along each of the lines in succession, and the length of the figure along such lines marked off along the edge of the paper; the total length so marked off is measured on the scales at the top of the instrument, giving the area of the figure in square inches or square centimeters, as required. For quicker and less accurate work, either only the dotted or full lines need be used, the length being multiplied by two.—Lond. *Electrician,* Jan. 3.

Electric Welding.—C. B. AUEL.—An illustrated article on the use of the Benardos process for welding by means of the electric arc. The metal to be welded forms the positive terminal of a direct-current circuit while a carbon electrode forms the negative terminal. The source of supply is a direct-current dynamo rated at about 85 kw and from 100 to 125 volts. There is also required a rheostat, two water-tight barrels placed side by side being very satisfactory for this purpose. A diagram of connections is given in Fig. 5. The procedure in applying

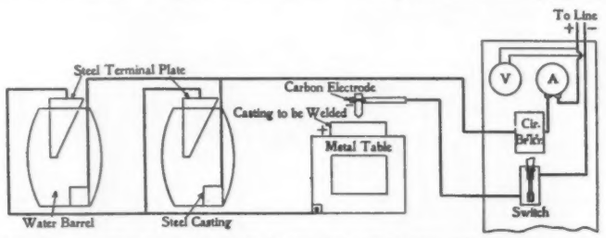


FIG. 5.—DIAGRAM OF CONNECTIONS FOR ELECTRIC WELDING OUTFIT.

the process to the welding of steel castings, pipes and plates is described. If possible the weld should be made with one continuous application of the arc without allowing the casting to cool off, since otherwise oxides will be formed.—*Electric Journal,* January.

Soldering Materials.—M. CORSEPIUS AND A. LIPPMANN.—A polemical discussion of several points in the recent article of Lippmann, with special reference to the use of "tinol" as a soldering material.—*Elek. Zeit.,* Dec. 19.

Laboratory.—An illustrated description of recent extensions of the laboratories of the University College, London.—Lond. *Electrician,* Dec. 27.

BOOK REVIEW.

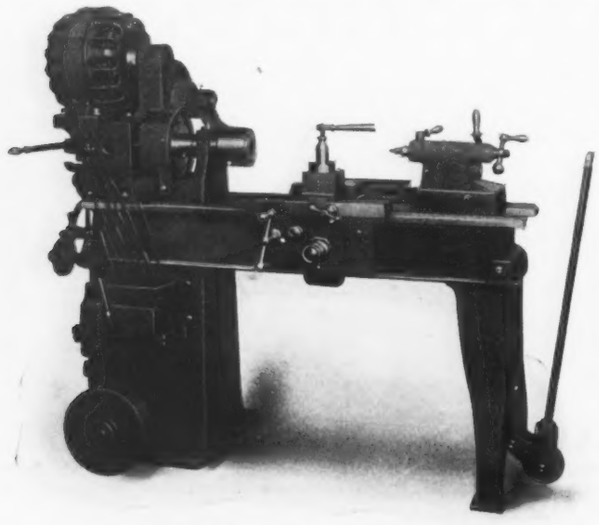
ELECTRICAL ENERGY. By Ernst J. Berg. New York: McGraw Publishing Company. 184 pages; 120 illustrations. Price, $2.50 net.

This book, which deals with the generation and transmission of electrical energy, has been compiled from a series of lectures delivered at Union University. The contents could be summarized briefly as applications to engineering problems of the equations deduced from a theoretical consideration of alternating-current phenomena. To the student or the designer of electrical transmission systems, the book will prove particularly valuable, because the statements of the inter-relations of the various phenomena are illustrated in a striking manner by applying them to the solution of problems such as are encountered in practice.

There are two sections to the book. Section I is devoted to the transmission line, and Section II to the generating station. The former section contains what is probably the most easily applied accurate solution of transmission line problems available in text-book literature. Although mathematical equations are used freely, and, in fact, the whole treatment rests on a mathematical basis, yet the systematic substitution of actual constants for the mathematical symbols allows the author to keep closely in touch with the physics involved and causes the reader to appreciate thoroughly the real phenomena being dealt with. Section II relates to generators, stationary transformers and station instruments. In this portion of the book the author has found less need for mathematical demonstrations, and has resorted more freely to descriptive methods of presentation. As in Section I, however, examples from actual practice have been selected for illustrating the physical relations being described. The book is well arranged for college classes, and will be welcomed by instructors in electrical engineering as covering many points that have not previously been given sufficient consideration in text-books.

Portable Motor-Driven Lathe.

The portable bolt-turning lathe illustrated herewith has been designed for use in locomotive repair shops. The unit is compact in design, and is mounted on wheels. It can be lifted by a crane and placed beside an erecting pit, and then shifted as



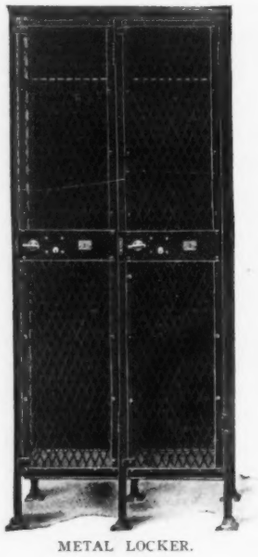
PORTABLE MOTOR-DRIVEN LATHE.

desired by hand. When in working position the machine rests on the two rear wheels and the front legs. To move it the front wheel is brought into contact with the floor and the legs are lifted by simply lowering the handle, which acts as a lever.

The motor which operates the machine is of the induction type, 2-hp, 1700 r. p. m. It is connected through a friction clutch providing for either 200 or 400 r. p. m. of the spindle. Energy is supplied to the motor by means of a flexible cable. The lathe has been built by the Williams & Wilson Company of Montreal, Canada, the motor being supplied by the Westinghouse Electric & Manufacturing Company.

Metal Locker.

To the central station company or other corporation employing a large number of persons, the value of a metal locker as a clothes receptacle is generally recognized. The "Pen-Dar" metal lockers, made by Edward Darby & Sons Company, of 233 Arch Street, Philadelphia, being constructed entirely of open-mesh, permitting a free circulation of air, in consequence of which they are well ventilated and sanitary. Moreover, the contents of each individual locker can be thoroughly inspected at any time. The locker is constructed of expanded metal by a patented process. The material is made from planished steel plate, cut, expanded and then rolled in such manner that it presents a smooth surface entirely free from rough edges or corners. Each locker is equipped with one shelf, three coat



METAL LOCKER.

hooks, individual brass number plates, and a special three-point locking device, which fastens the door at the top, center and bottom with a single turn of the lock. The lockers are finished in various colors, and each lock is provided with two non-changeable keys.

A Meeting of Allis-Chalmers Managers.

A meeting has just been held of department and district office managers of Allis-Chalmers Company from every industrial center of the country. During the entire meeting, which lasted four days, beginning with a tour of inspection of the works at West Allis and ending with a banquet at the Hotel Pfister, in Milwaukee, the prevailing note was that of decided optimism. With the possible exception of a single district, which depends for its prosperity upon one particular product, reports indicate that a general resumption of business activity is being brought about at the present time, and the outlook for purchases of material of all kinds, particularly power and electrical machinery, is most encouraging. Many of the district managers stated, in fact, that during the past two weeks inquiries have been very heavy, and customers are only waiting until a little more complete restoration of normal conditions to place large orders for apparatus.

One of the facts emphasized at the meeting was the advantage both to Allis-Chalmers Company and the purchaser of taking contracts for the complete equipment of power and lighting

plants, electric railway installations, industrial works, such as cement mills, flour mills, saw mills, ore reduction works, stone crushing plants, etc., which the company's extremely varied line of machinery enables it to do, thereby eliminating any division of responsibility and insuring the harmonious working of all parts of the apparatus, from bearing boxes, gears and pulleys to the heaviest machinery used in the plant, of whatever character it may be, thus guaranteeing the operation of the plant as a unit rather than the performance of the individual parts.

Following is a list of the managers present: F. C. Colwell, manager, Cincinnati; J. U. Jones, manager, Dallas; E. T. Pardee, manager, Boston; M. W. Thomas, manager, Atlanta; J. F. Harrison, manager, flour mill machinery department; B. A. Behrend, chief electrical engineer; J. W. Gardner, manager, Chicago; J. Weidman Murray, manager, Pittsburg; W. L. Loveland, manager, mining machinery department; St. J. Chilton, manager, Philadelphia; F. L. Bunton, manager, St. Louis; F. C. Randall, manager, New York; Roscoe Cornell, manager, El Paso; Geo. A. Williams, manager, Cleveland; P. H. Carey, manager, Detroit; C. R. Tatem, manager, Buffalo; H. D. Scribner, manager, San Francisco; A. E. Mosier, manager, Kansas City; A. H. Whiteside, manager, electrical department; R. B. McConney, manager, Denver; L. M. Harvey, manager, Milwaukee; E. T. Adams, manager, gas engine department; J. H. Denton, manager, air brake department; I. L. Skeith, manager, saw mill machinery department; M. C. Miller, assistant to the president; W. J. Sando, manager, pumping engine and hydraulic turbine departments; W. E. Dodds, manager, steam engine department; J. C. M. Lucas, manager, Baltimore; H. Schifflin, manager, crushing and cement making machinery department; W. H. Powell, superintendent electrical works; J. R. Jeffrey, secretary Bullock Electric Company.

One of the Displays at the Chicago Show.

The exhibit of the Western Electric Company was divided into two parts, the telephone exhibit and the supply and apparatus exhibit. The telephone exhibit was located in Section "D." A full line of magneto and common battery switchboards was displayed, as well as all kinds of telephones, including local and common battery and intercommunicating sets. A self-restoring drop board was connected up and in full operation. In addition to the above, a full line of standard construction material was shown, also a full line of cable terminals. Show cases were located in different parts of the exhibit filled with all parts which go to make up standard Western Electric Company switchboards and subscriber sets, and illustrated the high grade of workmanship and material which is used in its apparatus. This exhibit was the most complete of its kind ever placed on public exhibition as to telephone manufacture.

Directly across the aisle to the east of the telephone exhibit, in spaces 5, 6 and 7, was the power apparatus and supply exhibit. A specimen of the work turned out by the Western Electric Company at its Hawthorne works, covering an area of about 110 acres, was afforded in the 400-kw, 60-cycle, three-phase, 2300-volt alternator. While this 400-kw engine-type alternator is really a watch charm when compared with the larger machines manufactured by the Western Electric Company, it was the largest alternator that could be exhibited due to the danger of the floor giving way. Another interesting exhibit of engineering and mechanical skill was found in the 15-kw, 250-volt direct-current engine-type generator exhibited close to the 400-kva alternator. This small 15-kw generator is one of the smallest generators manufactured for direct connection to an engine and has a vertical divided frame. The frame of this generator is semi-steel and the pole pieces laminated.

For a number of years the company has manufactured a five-light testing regulator that can be used for testing series alternating-current lamps during the day with a maximum voltage of 440, thus eliminating the danger to lamp repair men when using a larger regulator. This regulator can also be used for lighting from 440-volt power circuits, and for this class of services it is suggested to operate five series alternating-current lamps in connection with the regulator. An equipment of this kind was on exhibition and connected up so that the operation of the lamp and regulator could be demonstrated. The new Western Electric 400-volt, multiple alternating-current lamp was on exhibition, and sample 110-volt alternating-current and direct-current lamps were also included in the display of lamps. This company has recently formed a selling arrangement whereby it becomes a distributor of the Beck flaming arc lamp, and two of these lamps were on view.

An interesting feature of the supply exhibition was the "Black Enamel" wire, attractive in comparison with silk and cotton insulation, owing to the small amount of space required by the wire, the greater number of feet per pound, and the high insulating quality. A line of supplies manufactured or handled by the company was also on exhibition, including American transformers, Vulcan heating apparatus, street railway material, "Electrose" insulated material, Thomas high-tension insulators, Duncan wattmeters, D. & W. fuses, and Deltabeston wire.

The Manufacture of Insulating Tape.

Mr. F. J. Gleason, the superintendent of the Massachusetts Chemical Company, Walpole, Mass., has favored us with the subjoined practical observations on the manufacture of insulating tape:

When you receive a nicely done up package of electric tape, label executed in several colors, with an imposing trade name, handle it gingerly till you know its pedigree or you may find that another lemon has arrived. Electric tape is, in a word, the simplest and most complex product the rubber manufacturer has to deal with. It is simple because the roll is round. It is complex because thousands of dollars may be spent on machinery and material, yet lack of knowledge in the compounding and coating results in an absolute failure.

Tapes must be made on a first-class cotton base. No inferior product will do if you want first-class output and no returned goods. The cotton must be dried out until absolutely no moisture remains or the rubber will not properly impregnate. I mean impregnate, for a first-class tape must have the compound driven into every pore of the fabric under enormous pressure and low temperature (comparatively speaking). Then on top of this impregnating comes the final coating built up to accurate thickness by micrometer.

It takes expensive machinery to do all these things, also years of experience, many failures, and every bit of honesty a man can dig up to make a success of the tape business. The great drawbacks to the use of ordinary tapes are "drying out" in the roll, and improper adhesion. Some tapes have no adhesive properties at all at low temperatures and are so sticky above 80 deg. that they cannot be used. Deterioration or rotting of the fabric is another drawback. All of these faults are due either to ignorance or dishonesty, ignorance in the secrets of compounding, dishonesty in loading the compounds full of foreign substances to increase weights and decrease the amount of rubber used.

It pays to be honest in the tape business the same as it does in all other lines, for it does not improve a concern's chances for reorders if the tape ordered dries out in the storeroom or gets rotten and the linemen cuss the maker's name on the package and all his works.

Just one word in closing about white tapes. Unless one pays an almost prohibitive price, he cannot produce a good white tape. Ingredients are put in all tape to preserve them, and a colorless preservative is yet to be found that will flux properly with white rubber.

I have tried to free this article of the personal note, and the lauding of our own products as much as possible, but the history of tape in the United States might almost be said to begin with our organization, and to advance as we advance. To those who are contemplating the manufacture of tape, I would say, go straight with your eyes open and with absolute knowledge of your product or don't go at all.

New Power Plant of the Pacific Mills.

The Pacific Mills, at Lawrence, Mass., are among the largest textile mills in the country having a cotton department with 180,000 spinning machines and 6717 looms, a worsted department of 53,064 worsted spindles and 2650 looms, and a print works with 27 printing machines. With the natural increase in the size of the plant, and the constantly increasing demand for steam for manufacturing purposes, it has become necessary to reorganize the entire power plant on a comprehensive basis. At present it consists of two sets of water-wheels at the upper mill, one set at the lower mill, and several boiler plants and engines located in various departments.

The new power plant is located on Essex and Embankment Streets, about 800 ft. from the Merrimack River, from which an abundant supply of water for condensing and boiler feed is obtained, and beside the tracks of the Boston & Maine Railroad, over which coal is received. The plant is intended to operate in connection with such portions of the present power system as will remain in commission temporarily or permanently.

On the main turbine room floor are located three Allis-Chalmers turbine units of 2250 kilowatts rating on normal load, generating 60-cycle current at 2300 volts; a 75-kw engine-driven alternator capable of running in parallel with the above; a 50-kw steam-driven, a 55-kw motor-driven exciter, and a 12-panel switchboard.

The turbines are designed to run at 1800 r. p. m. Each is equipped with a centrifugal governor, and automatic overload and safety stop valves. The generators are of the revolving-field enclosed type, with forced ventilation. The air for this is sucked in by the rotating field through a duct leading to an air shaft, the opening for which is up near the roof, thus insuring a supply of clean, cool air. Each unit is supplied with oil by an oil pump mounted on its frame and direct-driven through gears. An auxiliary steam-driven pump supplies oil at starting.

In the basement are located the condensers, feed pumps, fire pumps, and feed-water heater. Two of the turbines are quipped with jet condensers having twin double-acting steam-driven air pumps. The third unit has a turbo-jet condenser set built by the Allis-Chalmers Company.

The present boiler installation consists of 12 horizontal, return-tubular boilers, arranged in batteries of four each. Space has been provided for 12 more boilers. New England roller grates are used. The steam pressure is 150 lbs. per sq. in., and the steam is to be superheated about 125 deg. F.

After leaving the superheater the steam passes into a 10-in. steel header, located in the boiler room and below the level of the turbine floor. Six-inch pipes feed the turbines direct from this header. Each turbine is provided with two valves, one at the steam chest and one at the header. The auxiliaries are fed from the header at two points.

The feed pumps normally take water from the overflow pipe from the condensers, but they may also use water from either the cistern or the city supply. Condensing water is taken from the Merrimack River through a 48-in. steel penstock provided with sluice gate and screens, into a large concrete cistern located under the west side of the turbine room basement. The sides of this cistern form part of the building foundations, and the bottom is low enough to insure an ample supply of water at all stages of the river. From this cistern the water is taken through the condensers and pumps, and is then returned to the river through another 48-in. steel penstock which discharges further down stream. Provision has been made so that later, if it is thought desirable, warm water from the condensers can be carried over to the print works for use in manufacturing processes.

The coal pocket is 209 ft. 6 in. x 52 ft. Coal is taken from this by a single-track trolley with a grab bucket. There are two lines of track for this in the coal pocket, one on each side of the trestle, the track being supported from the roof trusses. These two lines unite between the pocket and the entrance to the boiler room, so that a single line of track is carried down over the center of the firing floor inside of the latter.

All oil switches are mounted on the wall back of the switchboard, the operating levers being under the floor. The rheostats are on the basement floor. Machine and feeder leads are located on the basement ceiling. The feeder leads are taken to the north end of the turbine basement, where they are connected to the transmission cables by disconnecting switches.

The transmission system is entirely underground. All cables are three-conductor, stranded copper, insulated with varnished cambric and protected by a lead sheath. The cables are insulated for a working pressure of 5000 volts.

The conduit system is made of multiple duct vitrified tile laid in concrete, with joints wrapped with burlap soaked in cement. The manholes are generally about 300 ft. centers, with a maximum of 410-ft. centers. Racks are formed in the sides of these manholes by projecting courses of brick from the inside of the walls. They are built with concrete bottoms, 8-in. brick sides, and concrete tops, carried on old rails. Circular cast-iron covers are used.

The route of this conduit is such that it was necessary to cross the Boston & Maine Railroad tracks and Broadway, a public street, at about the same point. In order to facilitate any future work at this point, a concrete tunnel was constructed here, with its top about 3 ft. below the surface of the street and road. The cables here are carried in racks formed by projections in the sides of the tunnel.

At the outset the energy generated at the new plant will be used principally to supply what is known as the "Upper Mill" and Print Works, but provision is being made for the extensive application of electric motor drive throughout the entire establishment, divided as follows: Yarn mill, 1500 horse-power; Upper Mill, 3000 horse-power; Lower Mill, 3000 horse-power, and New Mill, 3000 horse-power.

Electric Hair Dryer.

The accompanying illustration represents an electrical hair dryer, manufactured by the Shelton Electric Company, Chicago. The apparatus consists of a small electric motor which drives a rotary blower. This blower delivers hot or cold air currents, the heating coils being cut in or out by turning a switch. The

ELECTRIC HAIR DRYER.

machine is light in construction, many of the parts being made of aluminum; the weight complete being only 2½ lbs. The apparatus is connected to a lamp circuit through a flexible cord and plug, as shown. This hair dryer is adapted to both alternating-current and direct-current circuits of 110 volts, and the current consumption is said to be very small. It is stated that a woman's head of hair may be dried in six minutes by the use of this machine.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The easier tone of the money markets made itself felt in the resumption of manufacturing activity in many lines, but the loss of purchasing power among the people has been increased by the large proportion of the unemployed. Trade and industry continued quiet, commodity prices quite generally moved downward; collections were backward; an increased quantity of railroad equipment was reported idle; less satisfactory reports as to demand come from the iron and steel and coal industries, and there was an increased disposition to discuss wage reductions as an offset to restricting production. Wholesale trade generally was slow to open, though heavy cuts in cotton goods by Western jobbers, equaled or exceeded by Eastern houses, attracted buying in these and kindred lines. Reports as to collections indicate slowness in meeting engagements. The backward movement of cotton to market is still said to be a bar to southern trade and collections, though a rather freer movement is reported at some Texas points. Additional reports of railway earnings show that the business offering the roads is declining. November, 1907, gross receipts, while larger than in 1906, were offset by increased cost of operation, and net for that month fell heavily, a gain of 3.8 per cent in gross being accompanied by a loss of 14 per cent in net. Some metal-working industries are running fuller, and lumber mills at the South and on the Pacific coast are reported resuming, but the mild weather or reducing factory consumption has caused accumulation of coal, and mine output may be restricted. While irregular, commodity prices have quite generally moved lower, prominent in this respect being wheat, cotton, and many varieties of cotton goods. Clothing manufacturers are slow to buy, pending definite tendencies in the goods market. The pig iron market relapsed into quiet following the temporary revival of the week previous. Outputs tend to slightly increase. Demand for steel rails and railway equipment was very dull, and light rails are off $2 a ton. New business in structural material was only moderate. Wire products, hoops and bands and tinplate, were in good request, and prices were firm. Copper was firmer though demand was dull, but business in finished lines showed a little improvement. Lake closed at 13⅞c., electrolytic 13¾c., and casting stock at 13½c. *Bradstreet's* reports 408 business failures for the week ending Jan. 23, against 431 in the week previous, and 252 in the corresponding week of 1907.

STATUS OF COPPER MARKET.—Inquiries among the leading consumers of copper in the electrical line during the last week brought out the facts that notwithstanding the comparatively low price of copper metal, the manufacturers are buying from hand to mouth, only enough for their immediate needs. Business stagnation is the primary cause, supplemented by lack of investment capital and a general feeling of uncertainty in regard to the copper market. The manipulations during the last half of 1906 and the first half of 1907, in its attempt to corner the market and fix the price of metal at 26 cents a pound, have not been forgotten, and rather wild rumors and reports of late, that before long it will be demonstrated that copper in large quantities can be profitably produced at prices ranging from 9 to 12 cents a pound, have contributed to make a poor copper market. "The facts are that the copper people have been playing horse with us," said a manufacturer whose company in its line is the second largest user of copper in this city, "and we are not sure where we stand. When business was booming last year and we had to have the metal, they boosted the prices. Those of us who bought in large quantities now have manufactured products on our hands which we are obliged to sell at a loss. This valve cost my house 97 cents to manufacture under the price of copper at the time the valve was made, but at the present market prices of the metal, we are obliged to sell it for 86 cents." In general, the opinion seems to be that the price of metal will not go lower. As Senator Clark has pointed out, the 13-cent copper has forced hundreds of low-grade mines to close. It is estimated that the large surplus of the Amalgamated Company has been absorbed in home consumption and foreign exports, if the reports of the exports are bona fide, and the gradual revival of business will create a demand for the metal which will force the price upwards. One close in touch with the United Metals Selling Company said last week that in all probability the price of the metal would be raised to 14 cents within the next month and at the least sign of increasing consumption on the part of the copper users, the price would be pushed higher.

NEW YORK FIRE ALARMS.—It is understood that Fire Commissioner Lantry, of New York, will soon apply for an appropriation for the purpose of replacing the old electrical equipment entirely with new wires, new alarms, new instruments and, finally, a new fireproof building for the headquarters. About $2,500,000 will be required. The New York Board of Fire Underwriters first called the attention of the department to the conditions when Nicholas J. Hayes was commissioner. Commissioner Hayes saw that conditions were dangerous, and so reported to the mayor. This was in September, 1905, but no actual steps were taken for the improvement of matters until John H. O'Brien obtained, when he was fire commissioner, an appropriation of $25,000 for the preparation of plans and specifications for a new system. These plans were submitted to the engineers of the Board of Estimate and Apportionment and of the Department of Finance on their completion in September, 1907, and were approved. Commissioned Lantry will soon ask for an appropriation, but unless the temper of those who control the municipal pursestrings changes he will have difficulty, as Chief Croker testified before the Commissioners of Accounts that the cost of the new system would be at least $2,500,000. Chief Croker said on the stand that the new alarm system was almost as necessary as an immediate supply of good hose. Messrs. J. J. Carty and K. B. Miller have given technical evidence as to the sad condition of the electrical system.

POWER IN BRAZIL.—The Sao Paulo Tramway, Light & Power Company have closed a contract with the State Government and are delivering over 500 horse-power to the authorities for operating the pumps which distribute water to various portions of the city. In this connection it is interesting to note that a recent letter to the Bureau of Manufactures from U. S. Consul-General G. E. Anderson, of Rio de Janeiro, says: "As electricity from water power is likely to be far cheaper in the near future than imported fuel, it is likely that the demand for power machinery will be confined almost entirely to electrical machines and water-power motors. There is a splendid field for water wheels, turbines, etc., all over South America. The industrial life of South America in the future is to center almost entirely about the development of its water power and the transmission of this power from falls to cities through electrical appliances. The sale of electrical appliances of all sorts ought to be pushed in Brazil immediately. The inauguration of electric-lighting services in a number of Brazilian cities within the past few months is soon to lead to an immensely increased demand for electrical specialties, lighting goods, small power plants, and everything of the sort."

THE DEAN ELECTRIC COMPANY has received an order from the Ironton Home Telephone Company for a complete common-battery exchange and subscribers' station equipment. The exchange apparatus includes equipment for 640 common battery lines and 20 magneto lines, and the ultimate number of lines provided for is 1000. The details of the specifications were determined by a purchasing committee that personally visited the Dean plant and looked over two large common-battery boards that were lined up on the assembly floor. These two boards were for Madison, Ind., and Mt. Vernon, Ohio. Other large orders lately received by the Dean Company include the following: Common-battery switchboard for the Pomeroy & Middleport Telephone Company, Pomeroy, Ohio; 25 private branch exchange switchboards for the Home Telephone Company of Detroit, Mich.; central-office equipment complete, for Oakwood and Ottawa, Ohio; and private branch boards for Sheboygan, Mich., and Schenectady, N. Y.

BUSINESS CONDITIONS.—Subjoined are two or three comments on current business conditions from well-known leaders in the electrical trade. Mrs. R. E. Gallaher, secretary for the New York Insulated Wire Company, says: "There is no need for pessimism. Business is almost at a standstill, but it is perhaps the best thing that could happen. It is a natural and normal period of retrenchment and readjustment following a wave of inflation and speculation. Business men hestitate to begin new operations on a large scale until the result of the year's crops can be forecasted and the presidential election is settled. The business world has stopped to take breath and it is well that it has done so. There is nothing the matter with Roosevelt, taken as a whole, and there is nothing the matter with the country, or with the American people. Everything will right itself if we are a little patient. Only the American people don't like to wait. Because some of them are not making to-day as much money as they were yesterday, they howl calamity. If they stopped long enough to take a rational, analytical view of the situation they would see that fundamentally the country is sounder than it was six months ago and that there is no reason in the world to feel blue." A representative from one of the leading electrical manufacturing concerns in the country, who has just returned from a trip West, speaks encouragingly of the conditions out there. "There seems to exist in the West," he said, "a feeling of optimism that, like a slowly moving wave, is pressing Eastward. As yet the business world has scarcely had time to recover from the crushing blow dealt it, but one cannot but feel in the very air the tone of encouragement, the optimistic view that prevails in that section of the country. The West has been hit as hard as the East, but they seem to have recovered more quickly out there and one hears much less of the calamity howling that seems to be in vogue here. In, Boston, too, I observed that the manufacturers and dealers in electrical apparatus have felt very little the stress of the crisis. That part of the country seems to have suffered least of all, perhaps because of the conservativeness of the people who do not go to extremes in times of prosperity and who are quick to trim sails and lighten ship at the first storm signals." Mr. J. W. Perry, manager electrical department of the Johns-Manville Company, said: "Business conditions are very slowly but very surely improving. Our orders for January will aggregate at least 25 per cent larger than December's business. Still it will be a long time before things are in the shape they were a year ago. The present number of orders from buyers is greater than at that time, but the volume of business is not as large. Consumers are buying from hand to mouth, often and in small quantities, and although I expect to see business pick up, more and more each month, I do not anticipate any marked change until after the presidential nomination has been settled."

OZONE-VANILLIN PLANT.—On Saturday, Jan. 25, fire damaged the plant of the Ozone-Vanillin Company at Niagara Falls. The works of this company are located on the property of the Niagara Falls Power Company, the buildings having formerly been occupied by the Atmospheric Products Company. Just how the fire started is a mystery, but it is thought that a still exploded. The damage is about $20,000, fully insured.

Financial Intelligence.

THE WEEK IN WALL STREET.—Notwithstanding the easier money situation, the stock market was heavy throughout the week, and the bullish speculation inaugurated immediately after Jan. 1 practically subsided, there being renewed activity on the part of bears and an increased disposition to pay attention to unfavorable factors, such as poor railroad earnings, the accumulation of idle railway equipment, the restricted demand for coal, and the expectation of unfavorable showings by steel manufacturers. One of the most cheering and important announcements of the week was the decision of a high Pennsylvania court, declaring the two-cent fare law unconstitutional. The somewhat sensational decline in American Smelting & Refining securities was naturally disquieting. Railroad earnings continue to fall off, and the managers are endeavoring to reduce expenses wherever possible. The banks made a further large gain in cash. There were many developments in the short-term note problem. The Hudson Company arranged a sale of $15,000,000 two-year 6 per cent notes; one of the sixteen railroads with outstanding short-term notes maturing this year, the Missouri Pacific, arranged to take up its loan, and two more, the Delaware & Hudson, and the St. Louis & San Francisco, entered into negotiations with the same object in view. Probably the most important development was that the reports of the railroad earnings now forthcoming display more and more decidedly the effects of the money panic, with its results of business depression and lighter railway traffic. Owing to the mildness of the season and the diminished requirements for fuel, the coal stocks were particularly weak, and, in fact, would seem to have been the objects of very decided bearish pressure. Some importance was attached to the coming quarterly report of the United States Steel Corporation, which is generally expected to make a poor showing; and this was used with some effect in bringing about a renewed depression of the United States Steel stocks. Electric and traction stocks were dull and weak, the strength noted the two previous weeks receiving a check. The result was net declines in almost every case. Following are the closing quotations of Jan. 27:

NEW YORK.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
Allis-Chalmers Co.....	6⅛	6	Interborough Met. com.	7⅝	5
Allis-Chalmers Co. pfd.	19⅛	19	Interborough Met. pfd..	20	16
Amalgamated Copper...	50½	—	Mackay Cos.	56¼	55
Am. Dist. Tel.....	—	39*	Mackay Cos. pfd.....	62¼	60
American Locomotive...	38	36⅝	Metropolitan St. Ry...	—	20
Amer. Locomotive pfd..	91	90	N. Y. & N. J. Tel.....	—	101
American Tel. & Cable..	—	55	United States Steel com.	—	28¼
American Tel. & Tel...107		107	United States Steel pfd.	—	92
Brooklyn Rapid Transit.	44⅛	45⅛	Western Union Tel....	57¼	57½
General Electric 120		119	Westinghouse com.....	48	42
Hudson River Tel.....	—	—	Westinghouse pfd.....	—	75

BOSTON.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
American Tel. & Tel...108		108¼	Mass. Elec. Ry. jfd....	48	48
Cumberland Telephone..	99	—	Mexican Telephone.....	1½	5½
Edison Elec. Illum.....209½		210	New England Telep...117		109
General Electric	—	121	Western Tel. & Tel....	6	—
Mass. Elec. Ry.....	11¾	11½	West. Tel. & Tel. pfd..	65	—

PHILADELPHIA.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
American Railways.....	43	43	Phila. Electric	6⅛	6⅛
Elec. Co. of America...	8⅝	8⅜	Phila. Rapid Transit....	16	16
Elec. Storage Battery...	29	29	Phila. Traction	88	88½
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
Chicago City Ry.....140*		166	Metropolitan Elec. com.	17	18
Commonwealth-Edison ..	87	—	National Carbon.....	53	55
Chicago Subway.....	—	—	National Carbon pfd...103¼		—
Chicago Tel. Co.....115		—			

*Asked.

HUDSON TUNNEL OUTLAY.—The Hudson Companies, organized to build and equip the Hudson River traction tunnels and their terminal buildings, have issued $15,000,000 in two-year 6 per cent notes, secured by $22,500,000 of the 4½ per cent convertible bonds of the Hudson & Manhattan Railroad Company. President Oakman, in a letter to the preferred stockholders, in which he states that the new securities are offered at par and interest by Harvey Fisk & Sons, explains that the directors have chosen to issue the short-term notes because of their unwillingness to sell any of the treasury assets under present conditions. The proceeds are to be used to continue the work of construction. In this connection President Oakman states: "The physical work of construction is progressing most satisfactorily, and upon completion of the present financing your company will be in a very gratifying condition, and should ultimately liquidate its obligations to its preferred stockholders in a satisfactory and profitable manner." The company will have the line in operation to Fourteenth Street in a few days. Regular service between Hoboken and Fourteenth Street will begin in a few weeks. Up to the end of 1907 the Hudson Companies had spent upon the entire project, including tunnels, stations, power houses, terminal buildings, equipment, and miscellaneous outlays a total of $34,190,164.

DIVIDENDS.—The directors of the Lawrence Gas Company have declared the regular semi-annual dividend of $4 a share, payable Feb. 1. Directors of the American Gas & Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 1. The directors of the Rochester Railway & Lighting Company have declared an initial dividend of 5 per cent ($5 per share of $100 and $70 paid in) on the common stock, and the dividend has been distributed. The American Light & Traction Company has declared a regular quarterly dividend of 1½ per cent on the preferred stock and 1½ per cent on the common, payable Feb. 1. Directors of the Automatic Electric Company have declared a quarterly dividend of 1½ per cent, payable Feb. 1. The directors of the New York & Queens Electric Light & Power Company have declared a semi-annual dividend of 2½ per cent on the preferred stock, payable Feb. 10.

GENERAL ELECTRIC FINANCES.—The excellent condition of General Electric finances is brought out in the application to the stock exchange to list $9,273,500 of 5 per cent convertible gold bonds and $3,726,500 of additional said debentures from time to time. The company submits a balance sheet which shows a profit and loss surplus for the seven months ending Aug. 31, 1907, of $5,601,192. Sales in that period aggregate $41,475,763, which established a new high record. The total profit and loss as of Aug. 31, 1907, aggregated $20,711,989. The consolidated income account for the seven months ending Aug. 31, 1907, follows:

Sales	$41,475,763
Royalties and sundry profits	113,970
Interest, dividends and discount	347,658
Total	$41,937,391
Cost of manufacturing and selling	33,640,973
Interest on debentures	118,309
Dividends paid, 4 per cent	2,576,918
Profit and loss seven months, ending Aug. 31	5,601,192
Total	$41,937,391

The consolidated balance sheet as of Aug. 31, 1907, shows:

Patents, franchises, good will	$1
Factory plants	13,226,976
Cash	9,986,113
Stocks	19,087,799
Bonds	1,149,574
Real estate, other than factories	308,931
Notes receivable	3,838,723
Accounts	25,129,019
Work in progress (cost)	4,702,933
Merchandise inventories (cost)	24,001,579
Total	$101,371,652
Capital stock	65,167,400
3½ per cent debentures of 1902	2,047,000
5 per cent debentures of 1892	55,000
Subscription to 5 per cent debentures of 1907	10,492,250
Accrued interest on debentures	137,811
Accounts payable	2,760,202
Profit and loss, Aug. 31	20,711,989
Total	$101,371,652

The proceeds from the sale of such debentures are to be used for the general purposes of the corporation, and particularly to increase the working capital. They are redeemable after June 1, 1911, on 90 days' published notice, at par and 5 per cent. premium, and accrued interest, subject to the right of the holder to convert such bond during the 90-day period into stock. They are also convertible after June 1, 1911, and until maturity, June 1, 1917, at the option of the holder, into stock of the company at par. The company has stock which has been duly authorized, but not issued, to an amount in excess of $41,000,000 at par. Provision has been made for the reservation of stock to be issued in exchange for this series of debentures.

TELEPHONE FORECLOSURE SALE.—An important foreclosure sale of telephone properties will take place in the Court House vestibule, Rochester, Tuesday, Feb. 4. For more than four months the bondholders of the United States Independent Telephone Company and the Independent Telephone Securities Company have been looking forward to the conclusion of the foreclosure actions brought by the Security Trust Company, as trustee under the mortgage, and the sale of the properties. The sale of the U. S. I. properties by Referee Conklin will be held at 10 o'clock in the forenoon of the day of sale, and that of the Independent Telephone Securities properties will take place one hour later. It is provided in the order of sale that 10 per cent of the purchase price must be paid at the time of sale, while the remainder must be paid within 30 days thereafter. It is also provided that the purchaser may turn in toward the payment any bonds that he may have in his possession, pro rata as to the net proceeds. For example, assuming that the purchaser owns one $1,000 bond, and the net proceeds of the sale are on the basis of $100 per bond, the bond held by the purchaser will be accepted at $100. Under the latter provision the reorganization committee will be able to bid up to the amount of bonds assenting to the reorganization. It has been said that the amount so turned in was upward of 60 per cent of the total amount outstanding. It is understood that the amount outstanding is $13,362,000, and 60 per cent of that amount is $8,017,200. It is not likely that the highest bid of the reorganization committee will reach that figure.

SPRINGFIELD UNITED STOCK.—The United Electric Light Company of Springfield, Mass., has been granted permission by the state gas and electric light commissioners to issue $350,000 of new capital stock, the issue to comprise 2500 shares at $140, in order to pay for additions to the plant and to retire notes. The books of the company on June 30, 1907, showed the value of the plant to be approximately $1,375,000. The proceeds of stock and bonds previously issued for construction have amounted to $1,306,000. The difference between these two amounts, or $70,000, clearly represents an expenditure for construction not previously provided from the issue of securities and was included in the company's floating debt on that day. From June 30 to Oct. 30, 1907, about $80,000 was spent for a large addition to the station and equipment, and $75,000 more for other additions to the plant, making $225,000 in all. About $125,000 more will be needed for work in progress or contracted for. The outstanding notes on Oct. 31 were $435,000. The company asked for new stock for an estimated expenditure of $445,000 during the five years ending June 30, 1912, but the board did not think that the plans were sufficiently definite to justify the approval of securities for such a purpose now. Therefore an order is adopted approving the issue of new stock of par value of $350,000 for the objects named in the petition, the proceeds of 1600 shares to cancel outstanding promissory notes, and of 900 shares to cancel obligations for the generating station. The price of the stock is fixed at $140 per share.

NORTHERN OHIO REPORT.—The Northern Ohio Traction & Light report for the year ended Dec. 31, 1907, is issued. The income account compares as follows:

	1907.	1906.	1905.
Gross	$1,909,060	$1,703,340	$1,552,970
Expenses	1,095,755	1,006,842	898,830
Net	$813,305	$696,498	$654,140
Charges	513,241	483,173	471,503
Surplus	$300,064	$213,325	$182,637
Dividends	158,778	113,527	.....
Surplus	$141,286	$99,797	.....
Previous surplus	710,296	.....	.....
Total surplus	$851,582	.....	.....
Depreciation	100,000	.....	.....
Profit and loss surplus	$751,582	.....	.....

The surplus shown is equal to 3 per cent on the $10,000,000 capital stock.

CHICAGO RAILWAYS COMPANY.—Advices from Chicago of January 25 state that the property of the West Chicago Street Railway Company and that of the North Chicago Street Railway Company, operated under the name of the Union Traction Company, have been sold at auction to the Chicago Railways Company, a corporation formed to reorganize the two systems. The Chicago Railways Company offered separate bids amounting to $2,090,000, and bid a lump sum of $2,000,000. No other bids were made. The sale was the outcome of the traction litigation which has dragged in the courts for years and has blocked the way to improved street car service on the north and west sides of the city. The decision of the Supreme Court of the United States, handed down on Jan. 23, was the last step in the court proceedings. It is said the new company will spend $12,000,000 in rebuilding the lines.

CONSOLIDATED GAS MONEY.—The Consolidated Gas Company of New York City has sold to N. W. Harris & Company the balance of the $5,000,000 of one year 6 per cent notes which the directors authorized last week. The bankers took $1,500,000 of the issue last week and held the rest under option. A representative of the bankers states that practically all of the notes have been sold to investors. This quick sale furnished cumulative evidence of the great increase in the demand for short-term securities which has sprung up within the last few weeks. The purpose of this gas issue, it was officially stated, is to provide for new construction at the company's Astoria plant and the extension of its electrical service by the New York Edison Company, which is again feeling the impulse of new business.

FEBRUARY DISBURSEMENTS.—It is stated that the February dividend and interest disbursement will exceed $70,000,000. Up to the present date the dividends declared upon the stock outstanding of the various railroads, industrial, public service corporations, and the banks and trust companies of New York City aggregate $25,291,565 as compared with $22,519,935 paid during February, 1907, while the total interest payable upon bonds by railroads, industrials, public service corporations, New York City and the United States Government will aggregate $35,332,830, as compared with $30,670,984 for February, 1907.

UNITED WIRELESS REPORT.—The United Wireless Telegraph Company has mailed to stockholders the following financial report as of Nov. 30, 1907:

ASSETS.

Good will and patent rights	$500,000
Treasury stock, preferred and common	6,659,110
Stock and bonds of other wireless companies	12,459,263
Works, Jersey City	23,405
Station, boat and ærogram equipment	229,988
Furniture and fixtures	4,085
Cash, accounts receivable	241,612
Total	$20,117,463

LIABILITIES.

Capital stock	$20,000,000
Bills payable	2,534
Accounts payable	114,929
Total	$20,117,463

As the company was only formed Feb. 14, 1907, no comparison with a former period can be made. The United Wireless was organized to take over the affairs of the DeForest Company and to unify wireless interests, and the president says the progress made during 1907 was satisfactory. In that time the number of ships equipped with the apparatus of the company has been considerably augmented, and a chain of coast stations completed from New York to Galveston. On the Pacific Coast a chain of stations from San Diego, Cal., to the Canadian border is practically finished. Land has also been acquired at Vancouver, B. C., for a station, and the erection of the plant at that point will begin as soon as the necessary permit can be secured from the Canadian government. Stations on the Alaskan coast will be established this year. President Wilson reports a number of orders for equipment from ship owners, and says the outlook for 1908 is that several hundred vessels will install the apparatus. Inquiry among shipping people indicates that the service they are receiving from the United Wireless is satisfactory. From this service the company is deriving a good revenue. The company has about 12,500 stockholders.

CHESAPEAKE & OHIO TELEPHONE.—The report of the Chesapeake & Ohio Telephone Company for the calendar year 1907 has been received by Speaker Cannon of the House of Representatives. The report, which is required by law, shows that in 1907 the telephone earnings of the company amounted to $1,084,753.01, and the real estate earnings were $64,748.08, a total amounting to $1,149,501.09. The expenditures during the year were: For general administrative expenses and taxes, $90,510.27; traffic expenses, $293,326.89; maintenance, $262,852.09; rentals and sundries, $62,684.53; real estate expenses, $61,303.08; interest $180,200.73—a total of expenses amounting to $950,877.59. The company's net earnings amounted to $198,623.50, of which there was charged off on account of depreciation the sum of $123,205.13, leaving a revenue balance of $75,418.37. The receipts on account of capital were $559,409.23, being the proceeds of the company's notes. The expenditures on account of capital were for the construction of underground conduits and cables, $197,644.05, and for the construction of poles and other aerial equipment, $19,860.74. The sum of $341,948.44 was expended for central office equipment. The total expenditures on account of capital were $559,400.23. Vice-President Bethall, of the company, who signs the report, fixes the cost of the company's plant, not including real estate, Dec. 31, 1907, at $3,878,257.12.

MACKAY TELEGRAPHS.—According to well-informed financial authorities in Boston, the fiscal year of the Mackay Companies, which closes the last of January, will show some shrinkage in both gross and net earnings from the previous 12 months. This is the outcome of the strike last summer and fall, and also the result of the business depression. It is understood that while the Postal Telegraph Company will show a sharp decline in earnings from the previous year, the gross receipts derived from the 25,000 miles of submarine cable lines will be actually larger in the year just ending than in the preceding 12 months. Officials of the company state that the decrease in the dividend balances of the operating companies is not serious enough to affect in the slightest the 4 per cent dividends which are being regularly paid on the $91,380,400 of preferred and common stock. The $800,000 received in dividends from the American Telephone Company this year is equal to over 20 per cent of the entire dividend requirements of the Mackay Companies.

WESTERN ELECTRIC TRANSFER.—It is noted that the time for the deposit of Western Electric stock in exchange for the convertible bonds of the American Telephone & Telegraph Company, under the plan announced a couple of months ago has expired. No extension was announced, but it is understood that the telephone company will accept further deposits offered within a reasonable time. At the Merchants' Loan & Trust Company, Chicago, trustee under the agreement, it was stated that a little less than half of about $6,000,000 of Western Electric stock not formerly owned by American Telephone had been deposited for transfer. The offer was $250 par value in convertible telephone bonds for $100 par value of Western Electric stock, the telephone company reserving the right, however, to take the stock for cash at $225 a share. Under the exchange into bonds the holders of Western Electric stock get a return of 10 per cent on their investment instead of 8 per cent, which the shares now pay.

KEYSTONE TELEPHONE ANNUAL.—At the Keystone Telephone Company's annual meeting in Camden, last week, several minority stockholders asked questions bearing on the policy and management of the corporation, but there was no opposition to the directorate ticket, which was re-elected. George L. Maitland, one of the minority stockholders, wanted to know why no dividends had been paid, in view of the surplus earnings of $107,740 over the fixed charges for the year. James Collins Jones, a director of the company, in reply said that the company had used surplus earnings for betterments and extensions, and that the purchase of the Eastern Telephone Company, of Camden, cost $300,000, of which $30,000 has been paid off. The Keystone Company, he said, could profitably use $500,000 new capital annually for the next four years. For six months ended Dec. 31, 1907, the surplus over fixed charges was $542,598.

HOLYOKE MUNICIPAL LIGHTING.—The annual report of the Holyoke municipal gas and electric lighting department, shows an increase of 27,000,000 cu. ft. of gas consumed, or about 20 per cent. The electric branch shows an increase of 28 per cent. During the year street light prices to the city have been reduced to $60 from $80, representing a decrease of about $10,000 in the total income of the department, but made possible by the general increase in the department's income. The plant has added 11½ miles of wire and 86 new poles during the year. The total income of the department was $307,227 from gas and electricity and $7,615 from coke. This income, less expenses, shows a profit of $54,930. Announcement has been made that the price of electricity will be reduced to 6 cents per kilowatt, from 10 cents. The new rate will go into effect Feb. 1.

MEXICAN TELEPHONE.—The Mexican Telephone & Telegraph Company reports the following earnings for the quarter and nine months of the fiscal year ended Nov. 30, figures in Mexican currency:

3 mos, Nov. 30.	1907.	1906.	Increase.
Gross	$96,472	$93,273	$3,199
Expenses	51,207	50,873	334
Net	$45,265	$42,400	$2,865
9 mos. Nov. 30.			
Gross	$293,397	$274,079	$19,318
Expenses	159,197	148,526	10,670
Net	$134,200	$125,552	$8,647

For the nine months the company spent in new construction in 1907 $61,919 and in 1906 $56,653. The number of subscribers March 1, 1907, was 6176, and on Nov. 30, 1907, 5880.

CANADIAN BELL DEAL.—The stockholders of the Bell Telephone Company, of Canada, have ratified the sale of the company's lines, buildings, equipment, and other assets in the province of Manitoba, for $3,400,000. President C. F. Sise states that he considered the bargain a good one for the company, as important reservations were made; for instance, the Bell Company has the right to operate lines in the province connecting Saskatchewan and Ontario, and the right to connect with the Manitoba Government lines on through business. The $3,400,000 forty-year 4 per cent bonds which the company will receive from the province will constitute a trust fund which can be utilized to pay for improvements to the company's present system.

GRAPHOPHONE EARNINGS.—The report of the American Graphophone Company for the year ended Sept. 30, 1907, shows an increase in net earnings of $152,585 over the previous year. The total income was $994,851, compared with $842,266 in 1906. The surplus for the year was $782,433, a gain of $149,937. The payment of preferred dividends left a balance of $635,753, which was equivalent to 24.18 per cent on the $2,626,450 common stock.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

GUNTERSVILLE, ALA.—The municipal electric light plant was recently wrecked by an explosion.

LITTLE ROCK, ARK.—The city is considering the question of erecting a new electric light plant and installing equipment capable of supplying electrical energy for 750 street arc lamps. The present plant supplies energy for about 350 arc lamps.

EUREKA, CAL.—H. L. Jackman, of the Eureka Gas & Electric Company, states that during the present year the output of the electric plant at the foot of Whipple Street will be increased 150 per cent. New machinery will also be installed at the plant of the North Mountain Power Company.

FRESNO, CAL.—The city council has refused to grant the Home Power & Light Company a franchise to construct and operate an electric light plant in this city.

HANFORD, CAL.—The Board of Supervisors has granted the Mt. Whitney Power Company a light, heat and power franchise.

MARE ISLAND, CAL.—Bids will be received until Feb. 4 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to deliver at Mare Island, Cal., a quantity of naval supplies as follows: Schedule 709—electrical supplies, etc. Schedule 714—insulating tape, magnet wire, etc. Schedule 717—motors, hoists, etc. Application for proposals will be furnished upon application at the navy pay office, San Francisco, or to the bureau. E. H. Rogers is paymaster-general.

OROVILLE, CAL.—The Great Western Power Company has petitioned the Board of Supervisors of Butte County for a franchise to erect electric transmission lines from the Big Bend power plant over the highways in Butte County.

PASADENA, CAL.—Horace M. Dobbins, president of the Pasadena Cycleway Association, has announced that he is at the head of a company that has been organized to construct an electric railway between Pasadena and Los Angeles, at a cost of $2,500,000. The company is capitalized at $5,000,000.

PLACERVILLE, CAL.—At a recent meeting of the City Trustees, Civil Engineer White, of Southern California, submitted a report concerning the cost of installing a municipal electric lighting plant to be erected at Smith's Flat, four miles above Placerville, at a cost of $20,000.

SAN DIEGO, CAL.—The Board of Supervisors on Jan. 11 granted a franchise to P. F. Schaniel and E. W. Jones to use the tidewater of False Bay for the purpose of developing power to generate electricity.

SAN DIEGO, CAL.—The City Council has granted a franchise to F. W. Peterson to construct and operate an electric railway on certain streets in South Diego.

AGUILAR, COL.—The town officials have granted the Hawkins & Barnett Machine Company, of Trinidad, a franchise to supply electrical energy for lamps and motors in Aguilar. The company will soon begin the construction of an electric light plant of sufficient output not only to meet the local demands, but also to furnish electricity for both lamps and motors to adjacent coal mines. The cost of the plant is estimated at $25,000.

NEW HAVEN, CONN.—The capital stock of the United Illuminating Company has been increased from $1,000,000 to $1,500,000, the proceeds to be used for extensions and improvements to its plant.

SOUTH NORWALK, CONN.—The citizens of East Norwalk are contemplating installing an electric lighting system and have submitted a proposition to the City Council of South Norwalk asking that the city furnish from its municipal electric plant electrical energy for operating the system. The town of East Norwalk proposes to erect its own distributing system, and secure electricity from the South Norwalk plant to operate a 50-hp motor-generator.

WASHINGTON, D. C.—A bill has been introduced in Congress by Congressman Russell, of Missouri, asking for permission to erect several dams across the White River, in southern Missouri, for the purpose of developing the water power to generate electricity for different enterprises in that part of the state. It is said that W. H. Standish, of Aurora, Mo., is interested in the projects. Mr. Standish states that he already has the necessary capital pledged to carry on the work, if Congress will grant permission for the construction of the dams.

MIAMI, FLA.—The board of trade has presented a request to the city council that street lamps be placed over the principal street crossings in the city. W. D. Avery, of the electric light company, informed the council that the company would install all the lamps and supply electricity on a moonlight schedule for $85 per lamp per night.

MACON, GA.—It is reported that the directors of the Macon Railway & Light Company are contemplating the extension of the Bellevue car line to the race tracks at Idle Hour Farm.

BOISE, IDAHO.—The Andrews Light & Power Company is to be incorporated, with a capital of $50,000, to construct a power plant on the Lemhi River, near Salmon City.

LEWISTON, IDAHO.—Frank McKean, of Chicago, Ill., representing Eastern parties, has submitted a proposition to the people of Lewiston to build an electric railway from Lewiston to Antone and Cloverland, a distance of 45 miles, at a cost of $2,000,000.

LEROY, ILL.—The City Council is considering the proposition to replace the arc lamps now in use in the city with 60-cp incandescent lamps.

SHAWNEETOWN, ILL.—The city of Shawneetown was enjoined Jan. 15 by Judge Creighton, of Fairfield, from buying the electric light plant recently erected in this city. The City Council recently voted to purchase the plant from Judge Richard Cadle, the owner, on its completion and test, for $17,000.

TOWER HILL, ILL.—The Town Council has granted a franchise to the Mattoon-Shelbyville-Pana-Hillsboro Interurban Railway Company.

WATERTOWN, ILL.—The Village Board has granted a franchise to W. H. Downing, of Silvis, to furnish gas and electricity for lamps and motors in Watertown.

BLOOMINGTON, IND.—The City Council has granted a franchise to the Grand Central Traction Company, which proposes to construct a railway between Indianapolis and Evansville.

CLAYPOOL, IND.—H. L. Oldfather and Arthur Smith, principal owners of the Peoples' Mutual Telephone Company, have sold the plant and lines connecting this city with Burket, Silver Lake and North Manchester to A. A. Mendel. The system will hereafter be operated in connection with the Mendel Telephone Company. Mr. Mendel announces that he will improve the service by rebuilding many of the lines and will give a metallic service to the business sections of Claypool.

CLINTON, IND.—Preliminary steps have been taken to organize a company to build an interurban railway from Clinton to Danville, Ill. The Commercial Club of Clinton will endeavor to interest Terre Haute and Danville capitalists.

FRANKFORT, IND.—The promoters of the Frankfort, Delphi & Northern Traction Company are making arrangements to complete the railway between Frankfort and Delphi. The right of way has been secured for a distance of 27 miles. The company proposes to build a dam on the Wild Cat River at Prymont to generate electricity to operate the entire system. The company also plans to furnish electrical energy for lamps and motors to towns and cities along the proposed railway, having secured 25-year franchises in the towns along the route. The second section will be built between Delphi and Monticello, where a dam will be constructed in the Tippecanoe River.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company has asked the Board of Public Works to amend its present franchise, extending it by a period of 14 years, so that it will expire in 1938, instead of 1923, and also is asking to be allowed to increase its charges for service.

LAFAYETTE, IND.—This city is considering the construction and equipment of an electric light plant to run in connection with the water works plant. Prof. J. W. Ersterline, of Purdue University, will prepare plans and estimates.

VALPARAISO, IND.—The Town Board has granted T. E. Bell, of Harvard, a twenty-five year franchise to operate an electric light and gas plant in the town.

FT. DES. MOINES, IA.—Bids will be received until Feb. 12, by Captain John J. Boniface, constructing quartermaster, U. S. A., for furnishing and installing electric wiring, electric fixtures, etc., in the addition to subsistence storehouse and shelter for mounted guard at this post.

FORT DES MOINES, IA.—Bids will be received until Feb. 24 by Captain John J. Boniface, constructing quartermaster, for furnishing and installing electric wiring, electric light fixtures, etc., complete in a double set of captain's quarters, and two sets of lieutenant's quarters to be constructed at Fort Des Moines.

SIOUX CITY, IA.—The directors of the new State Telephone Company have authorized the completion of the extension of the twin cities line, the line on the Nebraska side of the Missouri River to Omaha and a line from Wayne, Neb., to Omaha. The cost of the construction of the above lines is estimated at about $125,000.

BELOIT, KAN.—A. Simpson, city clerk, writes that about $20,000 will be expended for a water works and electric light plant. No engineer has been selected as yet.

CLAY CENTER, KAN.—Extensive improvements are contemplated by the Clay Center Telephone Company to its system in this city, which will involve an expenditure of about $14,000.

ELKTON, KY.—The Todd County Home Telephone Company has increased its capital stock from $60,000 to $100,000. B. B. Petree is president.

MAYFIELD, KY.—The Mayfield Water & Light Company is contemplating making general improvements to its plant and installing about 30 arc lamps. C. R. Boone is superintendent.

PADUCAH, KY.—Plans and estimates are being prepared for the Paducah & Southern Electric Railway Company by the Westinghouse

Electric & Manufacturing Company for the proposed interurban railway between Paducah and Mayfield.

AUGUSTA, ME.—Bids will be received until Feb. 25 by the commanding officer of the Augusta Arsenal for furnishing and delivering electric switchboard, motor generator sets, motors, air compressor, metal working and wood working machines, some with motor drive, pneumatic hammer, electric and overhead cranes, fuel oil furnaces, testing machine, etc.

BANGOR, ME.—Owing to the refusal of the Eastern Manufacturing Company to pay $1,500 on Jan. 14 to the Bodwell Water Power Company, as suggested by Judge Putnam, of the United States Circuit Court, at Portland Jan. 11, the receivers of the Bodwell Water Power Company have closed down the plant at Milford.

BUCKSPORT, ME.—The new power plant of the Penobscot Bay Electric Company, on Alamoosook Lake, is nearing completion and will be ready for operation in about six weeks. It is expected that it will have an output of from 800 to 1200 horse-power at the start. The transmission line to Bucksport has been completed and as soon as the plant is completed the streets of the town will be lighted by electricity. William M. Shaw, of Greenville, is president of the company.

NORTHPORT, MAINE.—An effort is being made to have electric lamps installed at East Northport and the Camp Ground. C. O. Dickey is interested in the movement.

BROOKLINE, MASS.—The citizens have voted to appropriate $2,000, to be used by the committee appointed some time ago to consider the construction of a municipal electric light plant, to complete its investigations and to obtain expert advice. The Selectmen were also authorized to appear before the State Gas and Electric Light Commissioners to obtain a reduction in the price of electricity furnished to the town.

CAMBRIDGE MASS.—The city council has decided to petition the legislature for permission to construct, maintain and lease conduits for electrical wires, in the city of Cambridge.

CHARLTON, MASS.—The citizens are considering the question of making arrangements to secure electric service for lighting the residences and public buildings in the town. At present the only building lighted by electricity in the town is the Town Hall, the service being supplied by the Worcester & Southbridge Street Railway Company.

GROVELAND, MASS.—The town of Groveland is now lighted from the municipal electric light plant which was started during the past week. Electrical energy for operating the system is furnished by the Haverhill Electric Company. The street lighting system consists of 230 incandescent lamps.

HOLYOKE, MASS.—Announcement has been made by the officials of the American Writing Paper Company that a new power house will be erected in this city in the near future to supply power to five of its factories here. The new building will be erected on the banks of the Connecticut River and will cost about $100,000.

IPSWICH, MASS.—Ex-Senator G. A. Schofield has filed a bill petitioning the legislature to authorize the Ipswich Electric Light Company to issue $30,000 in bonds to provide for future extensions to the plant.

SPRINGFIELD, MASS.—The State Gas and Electric Light Commissioners have granted the United Electric Light Company permission to issue $350,000 additional capital stock, the issue to comprise 2500 shares at $140 per share, to pay for additions to plant and to retire notes.

BERRIAN SPRINGS, MICH.—F. A. Bryan, vice-president of the Berrian Springs Power & Electric Company, which is building a large dam in the St. Joseph River, states that the company has secured all rights for the construction of another dam in the St. Joseph River at Bertrand, and on which work will commence as soon as the Berrian Springs dam is completed.

CRYSTAL FALLS, MICH.—Extensive improvements and additions are being made to the municipal electric light plant, including the installation of a 300-kw Fort Wayne, three-phase generator, two 300-hp Leffel turbines. Q. Stephany is manager.

DETROIT, MICH.—The public lighting commission will submit an estimate of $61,000 to the Board of Estimates for a new 2000-kw turbine unit for the municipal electric light plant.

DETROIT, MICH.—Two electric cranes have recently been installed in the plant of the Detroit Steel Cooperage Works, together with a 125-kw generator for the operation of the cranes and other tools. The equipment was installed by the Detroit Engineering Works.

EVART, MICH.—The citizens are considering the question of changing the system of the municipal electric light plant from direct to alternating current and installing gas engines and producer gas plant. Perry Leach is superintendent.

GRAND RAPIDS, MICH.—The city council is considering the proposition of the Grand Rapids-Muskegon Power Company to take over the municipal electric plant and furnish electricity for the street lighting system. According to the proposition submitted to the council the power company agrees to assume all the initial expense in the purchase and installation of electric motors and appurtenances necessary to make the change, belting the present arc generators from these motors and allowing them to remain in their present location, so that should the occasion require, they could be belted and run from the engines as at present. The power company to maintain and operate the entire plant, delivering the energy at the switchboards to the street-lighting circuits, at the rate of one-half cent per lamp-hour, on a basis of 800 lamps. At the expiration of the contract the company to turn over the plant to the city in as good condition as when it took charge, barring ordinary depreciation. The contract is for a term of three years. It is estimated that the city will save about $6,000 a year by the change. Samuel A. Freshney is secretary and manager of the municipal plant.

HOUGHTON, MICH.—The Houghton County Street Railway Company is contemplating extending its line from Wolverine to Mohawk. W. H. McGrath is manager of the company.

HURON, MICH.—The Thorne Electric Company, of Bay City, has secured the contract for installing a system of electric lamps and motor equipment in the plant of the Huron Cement Company, at Alpena, at a cost of about $30,000.

NORWAY, MICH.—The City Council is considering the question of enlarging the municipal electric light plant.

STERLING, MICH.—Plans are being made by the Sterling Elevator Company to install an electric light plant in the elevator building. Jesse S. Hamlin is manager.

BRAINARD, MINN.—The city council contemplates installing a new generator in the municipal electric light plant.

EVELETH, MINN.—It is reported that the City Council is considering the question of the erection of a municipal electric light plant.

HINCKLEY, MINN.—R. P. Runckle and J. J. Colburne, of Cloquet, are seeking a franchise to construct an electric light plant in this place to be operated in connection with their proposed flour mill here.

COLUMBUS, MISS.—It is reported that David L. Parsons, of this city, is preparing plans for the construction of an electric light plant. The generating equipment will consist of 100 to 300 kw alternating-current three-phase machines, or 100 to 150 kw direct-current generators.

CALIFORNIA, MO.—The plant of the California Electric Light & Power Company has been leased to L. H. Ades, of Rockport, Ill., and Edwin Boyd, of Tipton. It is reported that the new management contemplates extending the transmission lines to Tipton.

FARMINGTON, MO.—An election will soon be held to vote on the proposition to bond the city for $20,000 to $25,000 to install a municipal electric light plant in connection with the water works system.

HALE, MO.—The plant of the Citizens' Light & Power Company has been sold to Edgar Jackson, of Carrollton, who will erect a new building and install a steam engine.

MAYSVILLE, MO.—At a special election held recently the proposition to isue bonds for a municipal electric light plant was defeated. Another election may be held.

MERIDIAN, MISS.—Frank Marty, of this city, is contemplating the construction of a new foundry, which will be furnished with electric motor drive.

ANACONDA, MONT.—Arrangements are being made to substitute electricity for steam power at the Washoe smelter. About 5000 horse-power will be used at the works. Electrical energy for operating the plant will be secured from the Hauser Lake dam, near Helena.

AUBURN, NEB.—It is reported that C. A. Snyder has submitted a proposition to the City Council to install an electric motor in the pumping station to pump the city water supply.

JOHNSON, NEB.—The citizens are considering the question of establishing a municipal electric light plant.

RENO, NEV.—Steamboat Springs, a summer resort, has been purchased from Colonel Hopkins by Dr. A. S. Brackett and associates. The new owners will expend $100,000 in improving the resort, which will include the building of an electric railway from Reno.

WINNEMUCCA, NEV.—The Utah, Nevada & Idaho Telephone Company, which is constructing a line from Salt Lake City to Reno, Nev., is contemplating the purchase of the Home Telephone Company's system, including the Paradise and Golconda lines. The new company is absorbing the local systems, having taken over the entire Ely County system. It is also stated that the Nevada Northern Telephone & Telegraph Company, operating in and around Lovelock, with its branch lines to Seven Troughs and Mazuma, will also be purchased by the new company.

HILL, N. H.—F. R. Woodward, proprietor of the New England Novelty Works, is installing a dynamo to generate electricity to light his factory.

RAYMOND, N. H.—It is reported that the local electric light plant owned by Charles A. Fox, has been purchased by Charles F. Gardner, of Brockton, Mass.

RIVERSIDE, N. J.—The Cinnaminson Electric Light, Heat & Power Company is rebuilding its lines and making arrangements to furnish a 24-hour service, and will furnish electricity for motors for manufacturing concerns. The company also furnishes electrical energy for the Camden & Trenton Railway Company, between West Palmyra and Burlington, and is rebuilding its lines between the two places. So far the new wires have been erected between Riverside and Riverton.

TRENTON, N. J.—Warden Atschley, of the New Jersey State Hospital for Insane, has recommended the construction of an electric light plant at a cost of $20,000.

ALBANY, N. Y.—The New York Central Railroad Company is making extensive improvements to its lighting system at the West Albany shops, which will require the rewiring of all the buildings at a cost of about $25,000.

ATTICA, N. Y.—The Attica Water, Gas & Electric Company has entered into an agreement to supply electricity for lamps for the village of Attica for one year ending Nov. 1, 1908.

BROOKLYN, N. Y.—The Coney Island & Brooklyn Railroad Company has decided to construct six sub-stations at a cost of $250,000, plans for which have been completed by Ford, Bacon & Davis, of New York City.

FRANKLINVILLE, N. Y.—The Empire Electric Light Company has applied to the Public Service Commission for permission to increase its capital stock from $2,500 to $12,500. G. W. G. Ferris is treasurer and general manager.

LEITCHFIELD, N. Y.—The City Council is considering the question of establishing a municipal lighting plant in this city.

LONG ISLAND, N. Y.—O. Brown, superintendent of the Long Island Cotton Mills, writes that the development of the Buffalo Shoals water power has been postponed until business conditions improve.

ROSLYN, N. Y.—The New York & North Shore Traction Company has filed with the Secretary of State a certificate of extension of route from Roslyn to Flushing. The Board of Supervisors of Nassau County has granted the company a franchise to extend its line from Floyd's Corners, Roslyn, to the city line at Little Neck. The road will run through Manhasset, Great Neck and Thomaston.

ROCHESTER, N. Y.—The capital stock of the Rochester Telephone Company has been increased from $550,000 to $1,050,000.

ROCHESTER, N. Y.—The Rochester Telephone Company has filed a certificate with the Secretary of State showing an increase in its capital stock from $650,000 to $1,050,000.

SYRACUSE, N. Y.—The City Council has decided to increase the appropriation for street lighting sufficiently to add 75 lamps.

CHARLOTTE, N. C.—The Southern Power Company is making arrangements to double the force at once on its water-power development at Rocky Creek. The company expects to finish the plant by September. The plant will have an output of 40,000 electrical horse-power, and is to be a duplicate of the Great Falls plant of the company, two miles distant. When this plant is completed the company will have an output of 100,000 horse-power. W. S. Lee is general manager.

NEWBERN, N. C.—A direct-connected unit is being installed in the municipal electric light plant to increase the output of the plant.

COLUMBUS, OHIO.—The city authorities here are preparing to demand that all electric wires be placed underground.

WARREN, OHIO.—The City Council is contemplating having plans and estimates made of the cost of installing and operating an electric light plant in case negotiations for the purchase of the local plant are not carried out.

YOUNGSTOWN, OHIO.—The City Council is considering the question of establishing a municipal electric light plant in this city.

YOUNGSTOWN, OHIO.—The Pennsylvania Railroad Company is erecting a large power plant at Lawrence Junction to furnish electricity to illuminate its yards from West Moravia, a distance of about four miles.

PERKINS, OKLA.—An election will be held Feb. 3 to vote on the proposition of the city buying the local electric light plant.

ARDMORE, OKLA.—The Ardmore Ice, Light & Power Company contemplates extensive additions and improvements to its plant, which will involve an expenditure of from $40,000 to $50,000. An addition will be erected to the power house, an 800-hp engine and a 175-kw generator installed.

OKMULGEE, OKLA.—We are informed that the Okmulgee Ice & Light Company is planning to install a 150-kw direct-connected unit in its plant this spring. W. W. Bavington is secretary and manager.

BROWNSVILLE, ORE.—The Brownsville Dam, just above the city, has given way, putting the electric light plant of the Brownsville Electric Light Company and other manufacturing plants out of commission. The dam cannot be repaired until the low-water period, which will be several months hence.

COQUILLE, ORE.—The Coquille River Electric Company contemplates installing a 250-hp engine in its plant this year. Frank Morse is manager.

PRINEVILLE, ORE.—The Prineville Light & Water Company contemplates installing a hydro-electric plant on the Deschutes River during the coming summer. Adrian Crooks is superintendent.

GRESHAM, ORE.—The Multnomah & Clackamas Mutual Telephone Company has increased its capital stock to $10,000.

HILLSBORO, ORE.—The City Council has decided to make improvements to the municipal electric light plant, and will install a new and larger generator.

McMINNVILLE, ORE.—Plans are being made for extensive improvements and extensions to the municipal electric light plant, which will include the rebuilding of the plant and rewiring the entire overhead system. Clarence Edwards, of Newberg, will have charge of the work.

SALEM, ORE.—John McNary, acting for the Portland, Eugene & Eastern Railway Company, has filed notice of appropriation of 2000 cu. ft. of water from the McKenzie River, in Lane County. A. Welch is manager of the company.

CHAMBERSBURG, PA.—The directors of the Chambersburg, Greencastle & Waynesboro Street Railway Company have awarded the contract for the additional electrical machinery and other equipment for the extension from Greencastle to Chambersburg to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., through the J. G. Schaff Electrical Company, of Chambersburg.

LIGONIER, PA.—The Borough Council has granted a franchise to Lesley W. Moore, of Kuhn, to erect and operate a telephone system in the Borough of Ligonier.

McADOO, PA.—The Consumers' Light & Power Company has taken a lease of the municipal electric light plant for a term of 25 years and will take possession Feb. 1.

PHILADELPHIA, PA.—Plans are being prepared by Chief McLaughlin, of the Electrical Bureau, for an elaborate electric lighting system with ornamental lamps for the Broad Street Boulevard.

SOUTH PITTSBURG, PA.—Extensive additions and improvements are contemplated by the New South Pittsburg Light & Power Company, including the installation of a three-phase, 60-cycle, 2300-volt system and extending its transmission lines to Dedford, Copenhagen and Bridgeport. C. A. Sutliff is owner and manager.

SUMMIT, S. D.—A stock company has been formed to install a local independent telephone system.

WAGNER, S. D.—The stockholders of the Farmers' Home Telephone Company have decided to increase the capital stock of the company from $8,000 to $25,000.

FORT WORTH, TEX.—The Northern Texas Traction Company will resume work on improvements to its power plant at Handley, which supplies electricity for the city and interurban lines. The cost of the improvements is estimated at $150,000.

HOUSTON, TEX.—The Houston Traction Company has been granted a franchise to build an extension of its lines to Harrisburg.

ARVONIA, VA.—The question of establishing an electric power plant in this town is under consideration.

CHRISTIANSBURG, VA.—The Grayson Electric Corporation, of Graysontown, and the lighting systems of Christiansburg and Grayson have been purchased by the Vaughn Construction Company, of Roanoke, Va., and will be operated under the name of the Grayson Electric Corporation. The company contemplates building an electric railway from Christiansburg to Cambria. The officers of the company are J. L. Vaughn, president; E. S. Hagan, vice-president, and A. A. Phlegar, secretary and treasurer.

LYNCHBURG, VA.—The Lynchburg Traction & Light Company is contemplating making extensive additions to the equipment of its plant, and will install a 1500-kw turbine, 900-hp boiler and one 750-kw rotary converter. R. D. Apperson is president and manager.

BELLINGHAM, WASH.—A sub-station will be erected in South Bellingham by the Whatcom County Railway & Light Company to be supplied direct from the plant of the company at Nooksack Falls. The company is making arrangements to supply electrical energy to the new flour mill now under construction.

ELMA, WASH.—The operation of the hydro-electric plant of the Elma Light & Power Company, located on Cloquallam Creek, about three miles from Elma, was started Jan. 12, and the plant is now furnishing electrical energy for the local system.

NORTH YAKIMA, WASH.—A company will be organized to construct an electric railway from Granger to North Yakima. Walter Granger, who has charge of the Government reclamation work in the Sunnyside Valley, is one of the leaders of the project: W. A. McDonald and J. H. Thomas are also interested in the project.

PORT ORCHARD, WASH.—John T. Mitchell, of Seattle, has presented an application to the board of county commissioners for a franchise to erect electric transmission lines over the county roads from Colby to Long Lake and vicinity, where extensive plans are being made for a summer resort.

SEATTLE, WASH.—F. X. Waldron & Company, of King County, has petitioned the commissioners of King County for permission to erect and operate an electric light, heat and power plant on Vashon Island, and to construct and operate an electric railway on the island.

SPOKANE, WASH.—Mines in the eastern part of Okanogan County and the Chekapa mines on the west, and the territory reaching from the British Columbia boundary on the north to Brewster at the mouth of the Okanogan River, on the south with boundaries to Chesaw and Molson, in north central Washington, will be supplied with electricity for lamps and motors by the Similkameen Power Company, which has recently been granted a 50-year franchise by the County Commissioners of Okanogan County. The company is capitalized at $1,200,000, and has a 1500-hp power plant at the falls of the Similkameen River, where it is proposed ultimately to develop 10,000 horse-power. The company also proposes to furnish electrical energy in the towns of Chesaw, Molson, Nighthawk, Loomis, Conconnully, Riverside, Omak, Okanogan and Brewster. The officers are Monroe Harman, of Oroville, president; Charles A. Andrus, of Nighthawk, vice-president and secretary, and H. W. Johnson, of Oroville, treasurer and general manager.

BRIDGEPORT, W. VA.—The citizens are considering the question of erecting a municipal electric light plant. The present street lighting system consists of 56 arc lamps, the energy for which the town pays $4,000 a year.

HUNTINGTON, W. VA.—The city is considering the question of placing a contract to light the city for a term of five or ten years; 160 arc lamps will be required. For further information address Rufus Switzer, chairman of fianance committee.

BALDWIN, WIS.—The capital stock of the Baldwin Telephone Company has been increased from $15,000 to $25,000.

BRODHEAD, WIS.—Plans are being formulated for building an independent farmers' telephone system in Decatur, taking in Spring Grove and Spring Valley.

CASHTON, WIS.—The citizens on Jan. 21 voted to issue $15,000 in bonds for the construction of a municipal electric light plant. An old mill property will be purchased and fitted up as a power plant.

CEDAR LAKE, WIS.—The capital stock of the Cedar Lake Telephone Company has been increased from $2,000 to $10,000. John Rosenheimer, Sr., is president of the company.

COLBY, WIS.—The electric light plant in Colby was recently destroyed by fire, causing a loss of from $6,000 to $8,000.

MILWAUKEE, WIS.—The council committee has recommended to the city council that the people be given another opportunity to vote on the question of building a municipal electric light plant. When the question was voted upon last time it was understood that a plant could be built for $500,000. Now it is maintained that a plant will cost at least $1,000,000.

OCONTO FALLS, WIS.—It is reported that the Oconto Falls Manufacturing Company has decided to rebuild its plant as soon as the insurance is adjusted. The company is contemplating the construction of a dam about a half a mile below the present dam. The dam, if erected, will furnish power to generate electricity to operate motors for the mill and to light the entire property. A. C. Merryman is president.

OSCEOLA, WIS.—The Village Trustees have granted C. C. Ladd, of the Osceola Mill & Elevator Company, a 20-year franchise to furnish electricity for lamps and motors in the village.

PORTAGE, WIS.—The Portage Electric Light Company has made application to the State Railroad Commission for permission to lower its schedule of rates in this city. The present rate is 15 cents to 10 cents per kw-hour. The new rate asked for is 10 cents to 6 cents per kw-hour.

SCHLEISINGERVILLE, WIS.—The Cedar Lake Telephone Company has increased its capital stock from $2,000 to $10,000.

SPOONER, WIS.—The stockholders of the Spooner division of the Badger Mutual Telephone Company have decided to withdraw from the company and organize another company under the name of the Burnett Washburn County Telephone Company. C. L. Keinztary is president of the company.

STURGEON BAY, WIS.—Henry Fetzer, of Sturgeon Bay, is interested in a project to develop water power at Potato Rapids to generate electricity to be transmitted by cable across Green Bay, a distance of twenty-two miles.

VIROQUA, WIS.—The Viroqua Electric Light Company contemplates rebuilding its plant in the near future and installing a new dynamo and engine. John M. White is manager.

NELSON, B. C.—The Nelson Electric Smelting Company is making arrangements to handle zinc, silver and lead ores by an electrical process, and expects to begin operation early in April. The plant is for experimental purposes only, and if the new principle is worked out successfully, a larger plant will be erected next fall.

CHIHUAHUA, MEX.—Enrique C. Creel has been elected president of the Compania Electrica y de Ferrocarriles of Chihuahua. This company recently took over the entire holdings of the Mineral Railroad Company and the street railway system and electric light plant company in the city of Chihuahua. The Mineral Railroad is at present a steam line which connects the Santa Eulalia mining camp with the city of Chihuahua and the new smelter. The plans of the new company call for changing the motive power of the Mineral Railroad from steam to electricity and to operate all the city lines by electricity. A large power plant will be built to furnish electrical energy for operating the railways, and also for lamps and motors. A. C. Nash is general manager of the company.

CULIACAN, MEX.—Francis Butterfield has been granted a franchise by the City Council to build a street railway system in this city.

GUADALAJARA, MEX.—Manuel Cuesta Gallardo, of this city, who holds a concession from the Federal Government for the available water power on the Santiago River for several miles, has begun the erection of a hydro-electric plant near Guadalajara. It will have an initial output of 6500 horse-power. He will build transmission lines to the city of Guadalajara and to the mining districts situated from 100 to 175 miles distant from the site of the power plant.

LINARES, MEX.—J. M. Bonilla, of Linares, is contemplating the construction of an electric railway in this town.

ORIZABA, MEX.—The Segura, Braniff Company has been reorganized under the name of Compania de Luz Electrica y Fuerza Motriz de Orizaba. The new company has a capital stock of $1,200,000 and proposes to install an electric light and power plant at Orizaba.

PUENTE DEL PASO, MEX.—Fernando Iglesias has advised the Federal Government that he will install a hydro-electric plant on the El Cliflon River, near this town.

SANTA ROSALIA, MEX.—Renato I. de Morambert, of this city, is arranging to establish an electric light and power plant in this place.

TULANCINGO, MEX.—Trinidad Herrera has entered into a contract with the municipal authorities of Tulancingo to install a hydro-electric plant at the Salto de la Granada falls near this place. The town will be furnished with electrical energy for lamps and motors by the proposed plant.

CEDAR HILL, N. M.—It is reported that the Eden Canal & Power Company is contemplating installing a large irrigation and power plant.

BRIDGEWATER, N. S.—The Micmac Gold Mining Company is planning to install a hydro-electric plant to furnish its mines with electricity, located seven miles from this town. The plant will be built on a tributary of the La Havre River, nine miles from the mines, where it is proposed to build a dam 200 ft. long and 15 ft. high. The present plans provide for the development of 400 horse-power, and provision will be made for developing additional power as needed. The company will install two water wheels, two generators, motors, turbine pumps, electric hoists, drills, tools, and will also need nine miles of wire and about 500 cedar poles. The cost of the plant is estimated from $45,000 to $50,000. Philip H. Moore, 2 Rector Street, New York, N. Y., is consulting engineer; W. B. Arnold, Boston, Mass., secretary.

HAMILTON, ONT.—Owing to a mistake said to have been made in a supplementary letter sent out after the specifications had been issued for the electric pumps and motors to be installed at the Beach, the fire and water committee has decided to call for new tenders for the pumps.

PORT ARTHUR, ONT.—The City Council has completed arrangements with the Kaministiquia Power Company for the supply of 525 kw of energy for lamps and for the operation of the street car system. Owing to the failure of the water supply it is necessary for the city to obtain electricity from other sources.

PORT HOPE, ONT.—A bylaw authorizing the Town Council to proceed with the erection of a municipal lighting plant was carried.

TORONTO, ONT.—Mayor Stewart has been informed by Hon. Adam Beck, of the Hydro-Electric Commission, that the commission is now in a position to make contracts with municipalities that have passed by-laws, and all that is necessary now is for the municipalities to state how much energy they will require.

UXBRIDGE, ONT.—The town of Uxbridge contemplates making application to the next session of the Legislature for permission to operate an electric light plant.

MONTREAL, QUE.—The Bell Telephone Company is making plans for many extensions and improvements to its system throughout Ontario. The most extensive work will be the improvement of the lines in and around Toronto.

PRINCE ALBERT, SASK.—The ratepayers have voted in favor of raising $50,000 for the extension of the electric light and water works systems. F. A. Creighton is city engineer.

New Industrial Companies.

THE ELECTRIC MANUFACTURING COMPANY, of New Orleans, La., has been incorporated, with a capital stock of $30,000, by A. G. Schrwiner, D. H. Comparett and others.

THE STIRLING ELECTRIC COMPANY, of San Francisco, Cal., has been formed to take over the business of the Century-Kline Company, dealers in electrical supplies. F. M. Greenwood is president and W. S. Goodman, vice-president.

THE RANDALL INSULATED WIRE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000, by Franklin S. Randall, of Weehawken, N. J.; Ira Mowry, of Morristown, N. J.; Bernard G. Heyn, of New York, N. Y.

THE WABASH AUTO & ELECTRIC COMPANY, of Terre Haute, Ind., has been incorporated to establish a plant for the manufacture and repair of automobiles, the manufacture of electrical supplies and to do a general electrical contract and construction business.

THE CHARLES A. SCHIEREN COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $1,000,000, by Charles A. Schieren, F. A. M. Burrell, C. A. Schieren, Jr., C. Arthur Schieren and Harry Victor Schieren. The company will manufacture leather and belting.

THE AJAX SPECIALTY COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $1,000. The directors are: Charles Smith, president and treasurer; George R. Porter and Walter B. Farmer. The company proposes to deal in telephone, electrical and mechanical appliances.

THE MASSACHUSETTS ELECTRICAL EQUIPMENT COMPANY, of New Bedford, Mass., has been incorporated, with a capital stock of $50,000. The company proposes to deal in machinery, electrical appliances, etc. The officers of the company are: Rufus B. Delano, president, and Walter M. Thomas, treasurer.

THE VAN-BERGH ELECTRICAL & MANUFACTURING COMPANY, of Winnipeg, Man., has been incorporated with a capital of $250,000. The directors are Hugh John Macdonald, H. Polson, A. Kennedy, W. McMillan, H. R. Hollinshead. J. Dobson, E. E. Yates, W. D. Pettigrew and J. MacKenzie, all of Winnipeg.

Company Elections.

MOBILE, ALA.—At the annual meeting of the Home Telephone Company held Jan. 14 the following-named officers were elected: J. C. Montieth, of Louisville, Ky., president; W. H. Bryant, of Mobile, vice-president and general manager; R. L. Douglass, of Mobile, secretary, and J. E. Bergin, treasurer.

CANTON, ILL.—At the annual meeting of the Illinois Central Electric Railway Company, held recently, the following-named officers were elected: Leslie W. Morton, president; M. W. Rafferty, vice-president; John V. Brokaw, second vice-president; W. D. Plattenburg, secretary; E. A. Heald, treasurer, and G. W. Chandler, general manager.

PEORIA, ILL.—At the annual meeting of the People's Telephone Company held Jan. 13 officers were elected as follows: B. F. Zinser, president; R. H. Truitt, vice-president, and J. S. Daily, secretary and treasurer.

BURLINGTON, IA.—At the annual meeting of the Citizens' Mutual Telephone Company held Jan. 11 the following-named officers were elected: L. F. Christy, president; Evan Evans, vice-president; Clarence Deupree, secretary, and E. K. Herr, treasurer.

TOPEKA, KAN.—At the annual meeting of the Topeka Street Railway Company the following-named officers were elected for the ensuing year: E. W. Wilson, president; L. E. Myers, vice-president; F. G. Kelly, secretary and treasurer.

AMHERST, MASS.—At the annual meeting of the Connecticut River Power Company, held Jan. 20, the following-named officers were elected: Charles F. Deuel, of Amherst, president; Philip Cabbott, of Boston, vice-president; M. A. Dickinson, of Amherst, treasurer, and C. W. Hazleton, of Turners Falls, clerk.

FALL RIVER, MASS.—At the annual meeting of the Fall River Electric Company held Jan. 13 the present officers were re-elected for the ensuing year.

GREENFIELD, MASS.—At the annual meeting of the Greenfield Electric Light & Power Company the following-named officers were elected: J. W. Stevens, president; G. W. Lawrence, treasurer; C. H. Keith, clerk.

HOLYOKE, MASS.—At the annual meeting of the Holyoke Street Railway Company, held recently, the following-named officers were elected: W. S. Loomis, president; L. D. Pellissier, secretary and treasurer.

SALEM, MASS.—At the annual meeting of the Salem Electric Lighting Company Charles H. Price was re-elected president and Henry M. Batchelder, treasurer.

HATTIESBURG, MISS.—At the annual meeting of the Hattiesburg Traction Company, held recently, the following-named officers were elected: A. F. Thomaston, president; H. S. Stevens, first vice-president; H. A. Camp, second vice-president; N. B. Blount, secretary and treasurer, and C. Z. Stevens, general manager.

FAIRMONT, NEB.—At the annual meeting of the Fillmore County Telephone Company held Jan. 11 the following-named officers were elected for the ensuing year: Otto Wettstein, president; M. Propst, vice-president; John Barsby, secretary and general manager, and E. K. Cobb, treasurer.

JOHNSTON, N. Y.—At the annual meeting of the Interstate Telephone Company the following-named officers were elected: Eugene Walrath, president; John Hurley, vice-president; George D. Hakes, secretary, and George D. Smith, treasurer.

RIVERHEAD, N. Y.—At the annual meeting of the stockholders of the Hollow & Roanoke Telephone Company held Jan. 14 the following-named officers were elected for the ensuing year: J. C. Young, president; H. R. Talmadge, vice-president; J. Frank Dimon, secretary and treasurer, and W. R. Fanning, general manager.

UTICA, N. Y.—At the annual meeting of the Ballda Electric Company held Jan. 16 the following-named officers were elected: H. S. Ballda, president; W. C. Ballda, vice-president and treasurer; F. E. Ballda, secretary, and R. W. Bryson, superintendent.

AKRON, OHIO.—At the annual meeting of the People's Telephone Company held Jan 14 the following-named officers were elected: Will Christy, president; C. W. Devoe, vice-president; Joseph S. Benner, secretary, and William F. Laubach, treasurer and general manager.

COLUMBUS, OHIO.—At the annual meeting of the directors of the Columbus Edison Company, the following named officers were elected: Otto Theobold, president; John Seibert, vice-president; Emil Kieswetter, secretary and treasurer, and L. F. Kieswetter, assistant secretary and transfer agent.

OTTAWA, OHIO.—At the annual meeting of the Farmers' Telephone Company held recently the following-named officers were elected: John Mallahan, president; P. A. Amstutz, secretary, and A. S. Hilty, treasurer.

TOLEDO, OHIO.—At the annual meeting of the Toledo Railways & Light Company held recently the present officers were re-elected.

ENID, OKLA.—At the annual meeting of the Oklahoma Rural Telephone Company held Jan. 14 the following-named officers were elected: George Raemer, of Fairmont, president; William Taggart, of Waukomis, vice-president, and Frank Bradfield, of Enid, secretary and treasurer.

DANVILLE, PA.—At the annual meeting of the Danville & Bloomsburg Street Railway Company held Jan. 13 the following-named officers were elected: Frank C. Angle, of Danville, president; Thomas B. Illig, of Reading, vice-president; W. C. Billman, of Reading, secretary, and C. E. Leippe, of Reading, treasurer.

EASTON, PA.—At the annual meeting of the Easton Transit Company held recently the following-named officers were elected: H. R. Fehr, president; S. H. Hackett, vice-president, and S. H. Sargeant, secretary and treasurer.

LEWISTON, PA.—At the annual meeting of the Lewiston & Reedsville Electric Railway Company the following-named officers were elected: W. H. Denlinger, president; James H. Allport, secretary, and H. F. Bigler, treasurer.

MANSFIELD, PA.—At the annual meeting of the Citizens' Mutual Telephone Company the following-named officers were elected: C. H. DeWitt, president; Finley Furman, secretary and treasurer.

MEYERSDALE, PA.—At the annual meeting of the Economy Telephone Company, of Somerset County held recently the following-named officers were elected: H. G. Will, president; R. S. Walker, secretary, and S. B. Philson, treasurer, all of Meyersdale.

ST. ALBANS, VT.—At the annual meeting of the St. Albans Electric Light & Power Company held Jan. 15 the following-named officers were elected: C. C. Chesney, of Pittsfield, Mass., president; George M. Bunting, of Philadelphia, Pa., vice-president; H. B. Hodge, of Philadelphia, Pa., secretary, and W. H. Vorce, of Dover, Del., treasurer. The directors are William E. Robertson, Frank H. Foote and W. H. Vorce.

PARKERSBURG, W. VA.—At the annual meeting of the West Virginia Western Telephone Company, held Jan. 16, the following-named officers were elected: J. H. Linger, president; J. E. Carl, vice-president; C. T. Hiteshaw, secretary and treasurer, and A. C. Davis, general manager.

LA CROSSE, WIS.—At the annual meeting of the La Crosse & Black River Falls Railway Company the following-named officers were elected: Mills Tourtellotte, president; Henry Gund, vice-president; H. J. Hirshheimer, secretary; F. P. Hixon, treasurer.

New Incorporations.

EARL, ARK.—Articles of incorporation have been filed for the Earl Light & Power Company, with a capital stock of $10,000, by C. C. Bird, C. T. Whitman, J. M. McBee and others.

DOWNIEVILLE, CAL.—Articles of incorporation of the North Yuba Electric Light & Power Company have been filed in Reno, Nev., the incorporators being Samuel B. Crane, Wm. B. Barstow and Earle Talbot. The company intends to construct and operate a power plant near the waters of the North Yuba River for the purpose of supplying electricity for lamps and motors to different cities and towns in Nevada and California. The capital stock of the company is placed at $1,000,000.

LOS ANGELES, CAL.—The Electric Construction Company has been incorporated with a capital stock of $100,000. The directors are W. F. Porter, A. C. Balch, W. G. Kerckhoff, W. W. Melviny and M. S. Graff.

NAPA, CAL.—The Vallejo Irrigation & Power Company has been incorporated, with a capital of $500,000, by Joseph A. Migliavacca, E. W. Doughty, W. G. Thompson, L. E. Johnson and Harry L. Johnson, all of this city.

SAN FRANCISCO, CAL.—The Feather River Water & Power Company has been incorporated with a capital stock of $1,000,000 by C. F. Metteer, S. A. Moss and A. E. Boynton.

ATLANTA, GA.—The Atlanta, Norcross & Gainesville Railroad Company has been incorporated by H. D. Jaquish, C. C. Sanders, W. B. Smith, J. H. Hunt, R. Smith, A. J. Mundy and others. The capital stock of the company is $15,000, with the privilege of increasing the amount as may be deemed necessary.

FITZGERALD, GA.—A charter has been granted to the Fitzgerald & Ocilla Electric Railway & Power Company, with a capital stock of $50,000, to construct and operate an electric railway between Fitzgerald and Ocilla, and to furnish electricity for lamps and motors. The incorporators are S. T. Holzendorf, of New York, N. Y.; L. C. Holzendorf, of Valdosta; C. P. Holzendorf, of Atlanta, and others.

WALLACE, IDAHO.—The North Idaho Telephone Company has been organized at Wallace, with headquarters at Kellogg. The capital stock is $25,000. The incorporators are D. W. Price, W. W. Papesh, W. F. Goddard, S. L. Shonts, Isaac Babbitt, P. P. Weber, L. W. Gay, Robert Sterling, Benjamin Carrigan, Curtis Lightner, Stanley A. Easton, W. C. Clark and A. M. Nash.

BELLEVILLE, ILL.—A charter has been granted to the Red Bud & Belleville Interurban Railway Company to construct an interurban railway from Red Bud to Smithton. The incorporators are Conrad Becker, Charles C. Smith, Herman Schryver, of Red Bud; John Keller, of Hecker, and Benjamin A. Gundlach, of Belleville.

CHICAGO, ILL.—The Western Illinois & Iowa Railroad Company has been chartered, with a capital stock of $2,500,000, by Paul A. Neuffer, Harry H. Phililps, James E. Hauronic, Charles J. Horn and Rollo M. Cole, all of Chicago. The object of the company is to construct an interurban railway in Hancock County.

HAMILTON, IND.—The New Home Telephone Company has been incorporated, with a capital stock of $25,000.

NEW ORLEANS, LA.—The New Orleans & Seashore Air Line Railway Company has been organized, with a capital stock of $1,000,000, by William F. Pinkard, Arsene Perrilliat, James W. Porch and John H. Menge, Jr. The company proposes to construct an electric railway from Jefferson Parish to Grand Isle.

RENO, NEV.—The Kings Hill Irrigation & Power Company has been organized for the purpose of erecting a power plant in this county. The men interested in the project are Charles and Benjamin Hammett, C. B. Hurtt, E. L. Hice and O. O. Haga, all of Boise, Idaho.

BURLINGTON, N. C.—The Burgrahaw Traction Company has been chartered with a capital stock of $250,000. Junius H. Hardin is one of the promoters of the enterprise.

SHELBY, N. C.—The Shelby Electric Light & Power Company has been chartered with a capital stock of $50,000, with the privilege of beginning business with $14,000. The incorporators are J. J. McMurray, S. A. McMurray, A. W. McMurray and J. C. Smith.

DAYTON, OHIO.—The Dayton Street Construction Railway Company has been incorporated with a capital stock of $1,000 by C. H. Bosler and others.

HINTON, OKLA.—The Cedarville Telephone Company has been incorporated by Hermann Constein, H. Z. Owen and J. Hoffman, of Hinton, and J. B. Barns, of Lookeba.

MARLINTON, W. VA.—The Marlinton & Academy Mutual Telephone Company has been incorporated by John Gay, of Marlinton; J. L. McNeel, of Millpoint: M. L. Beard and T. A. Stricker, of Academy.

Legal.

MAINE RECEIVERSHIP.—Eugene H. Mather, of Newton, Mass., general manager of the Bodwell Water Power Company, and Josiah W. Harmon, of Oldtown, were appointed receivers of the Bodwell Water Power Company, upon petition of the Central Trust Company, of New York, N. Y., which company holds a mortgage on the Bodwell Water Power Company's property for $1,000,000.

RECEIVER FOR TELEPHONE COMPANY.—The Citizens' Telephone Company, of Batavia, Ohio, has passed into a receiver's hands on the application of a stockholder, who alleged that the business was conducted at a net loss. The company controls 100 telephones, has 11 exchanges and 250 miles of wire in Clermont County. The court appointed Bailey W. Gilfian, of Columbus, receiver. Manager Baum said that the cause of the company going into the hands of a receiver was the low rates for service and the increase in operating expenses.

RIGHT OF A MUNICIPAL PLANT TO FURNISH ENERGY FOR PRIVATE PURPOSES.—A case against the village of Nelsonville, Ohio, has been taken to the supreme court of the state for a decision as to whether a municipal lighting plant has any right or authority to supply energy for private use. It is said that a number of companies, including the Cleveland Electric Illuminating Company, are interested in the case, the latter because the city of Cleveland expects to do a commercial business with the plant acquired on the annexation of South Brooklyn as a nucleus.

BAY CITY INJUNCTION.—A temporary injunction was issued by the Bay City circuit court Jan. 18 in the suit of the Bay City Electric & Traction Company against the city of Bay City, restraining the mayor and council; the Allis-Chalmers Company, of Milwaukee, Wis.; the Arbuckle-Ryan Company, of Toledo, Ohio; the Lang Electric Company, and the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., from entering into and carrying out contracts authorized by the council Jan. 13, relative to the establishment of a consolidated electric lighting plant at the old water works property on the west side.

RECEIVERSHIP IN NATCHEZ.—Acting under a decree of the Supreme Court, W. A. Pollock, recently appointed receiver for the Southern Light & Traction Company, which is operating electric light and street car systems in Natchez and Vicksburg, on Jan. 17 took charge of the local plant as trustee. The decision of the court is to the effect that the company is a trust under the laws of Mississippi, and declares the charter and franchise forfeited. Mr. Pollock will make his reports to the Chancery Court until the affairs of the company have been wound up and local companies organized to take charge.

INJUNCTION AGAINST DISCONTINUANCE OF SERVICE.—An application was filed in the Clayton Circuit Court, St. Louis, Mo., Jan. 17, by Paul D. Cable, president of the General Service & Development Company, asking for an injunction against the Union Electric Light & Power Company, the King Electric Light Company and its president, A. C. Einstein, restraining them from cutting off the electrical energy which they supply him and which he in turn furnishes to customers in St. Louis County. The application states that the General Service & Development Company contracted in 1905 with the defendants for electricity. The contract expired Jan. 18, and the defendants, it is alleged, refuse to supply electricity any longer.

Personal.

MR. R. F. RUDELL, member of the Stock Exchange firm of O'Loughlin & Rudell, has been elected secretary and treasurer of the Electric Development & Securities Company.

MRS. McINTOSH, formerly advertising manager of the Norton Company, has taken a similar position with the Buffalo Forge Company, the Buffalo Steam Pump Company and the Geo. L. Squier Manufacturing Company.

MR. G. E. MILLER has resigned as superintendent of the Union Electric Company, of Dubuque, Ia., to accept the position of general superintendent of the Chattanooga Railways Company, of Chattanooga, Tenn.

MR. A. H. VAN CLEVE, of Niagara Falls, N. Y., engineer in charge of the construction work of the Niagara Falls Power Company and the Canadian Niagara Power Company, has been appointed consulting engineer for both companies.

MR. W. B. SNOW, of Boston, has reprinted from the *Selling Magazine* for November his excellent article on exploiting the industrial application of a machine by the modern methods of publicity, and by work in a field where he is well known from his own success in such development.

MR. ARTHUR H. ALLEN, until recently connected with the Westinghouse Electric & Manufacturing Company, has opened offices at 1019 Land Title Building, Philadelphia, Pa., where he will hereafter represent a complete line of high-grade alternating and direct current generators and motors; also other electrical apparatus.

MR. P. B. DELANY, the well-known inventor and telegrapher, described and demonstrated recently before the Franklin Institute of Philadelphia, his ingenious telepost system for rapid automatic transmission of letters and other sorrespondence that would otherwise and as now go by mail. The apparatus worked very successfully.

MR. D. R. SMITH, the president of the Switchboard Equipment Company, Bethlehem, Pa., spent a large part of last week in New York City, attending to important business. He finds a very large demand for circuit breakers, and takes a very hopeful view as to the near future predicated on the sustained demand that the company had to meet even during the recent depression.

MR. J. S. McCULLOH, formerly superintendent of buildings for the New York Telephone Company, now holds the position of general contract agent in the same corporation. His former place is taken by Purchasing Agent D. C. Cox. Mr. McCulloh will have the supervision of all contracts made between the telephone company and its subscribers in Long Island, Manhattan and New Jersey.

MR. ARTHUR JACOB, of London, Eng., who for many years has been connected in turn with the British Thomson-Houston Company, the British Schuckert Company and the Siemens Brothers' Dynamo Works, Ltd., has severed his connection with the last named firm to assume control of the Commercial organization of the British Aluminum Company, of London, Eng.

MR. OSCAR C. TURNER, general manager of the Southern Electrical Company, of Nashville, Tenn., for the past three years, has just resigned to take an important position with the Warren Electric & Specialty Company, of Warren, Ohio. He will be succeeded by Mr. Harry E. Dyer, who went to Nashville with him and is in full touch and harmony with the policies he has inaugurated there.

MR. ALFRED A. WOHLAUER, consulting electrical engineer, in light and heat, has opened a professional office at 500 Fifth Avenue, New York City, and is now prepared to investigate and report upon all matters relating to electric light and heat, to design and supervise installations of that nature, and to consult as to the possibilities of new plants or the extension of old ones.

MR. H. H. VREELAND, president of the New York Railroad Club, is to be the guest at a complimentary dinner on Feb. 7, at a place to be designated later. This dinner is a highly deserved testimonial, and is in recognition of his devoted services to the club, which he has done so much to build up into a great and useful organization. Mr. W. G. Besler is chairman of the dinner committee, and Mr. H. D. Vought, secretary. A very large attendance is expected.

MR. B. F. PANKEY, of Topeka, Kan., who is president and general manager of the Independent Telephone Company, tendered his resignation at the annual meeting of the board of directors, held Jan. 16. Mr. Theodore Gary, of Macon, Mo., president of the National Independent Telephone Association of the United States and Canada was elected president of the company and Mr. W. P. Hemphill, of Topeka, Kan., was elected vice-president and general manager.

MR. CARL H. HOLLEY has resigned as general superintendent and chief engineer of the Mt. Whitney Power Company and will in future devote himself to general engineering work, with offices in the First National Bank Building, Visalia, Cal. He is associated with his brother, Mr. H. H. Holley, a civil and hydraulic engineer, and the firm will undertake any class of work in the range of modern engineering thus indicated. Mr. Carl Holley will also devote special attention to irrigation projects.

MR. WILLIAM W. POWER has recently been appointed manager of the electrical department of the Boston branch of the H. W. Johns-Manville Company. Mr. Power was formerly district manager of the Allis-Chalmers Company's Philadelphia office, and previous to that he was connected with the Christensen Engineering Company, as special representative throughout the New England States. When that company was reorganized and made the National Electric Company, Mr. Power continued with the latter concern until he became associated with the Allis-Chalmers Company. Mr. Power is well and favorably known in the New England States, and his wide experience in the electrical field will assist him in his new position.

MR. W. S. TURNER, B. S., a well-known electrical engineer and constructor, has joined the staff of W. S. Barstow & Company and has been placed in charge of their Portland (Ore.) office. He is a graduate of Knox College and Cornell University, and ever since graduation has been actively engaged, not only all over this country, but in New Zealand.

He did a good deal of the pioneer lighting and traction work, particularly for the Westinghouse, Edison and Sprague systems. For several years he was a member of the Woodbridge & Turner firm, which did a large amount of electrical design and construction. A man of ripe experience, thorough training and sound engineering judgment, he is a valuable acquisition to the Barstow forces, and he is already actively engaged on their extensive operations in the Northwest.

Obituary.

MR. W. L. TYLER.—The death occurred last week of Mr. Walter Lincoln Tyler, a member of the A. B. See Electric Elevator Company, New York City, from blood poisoning at his home in Brooklyn. Mr. Tyler was born in Brooklyn 41 years ago, the son of William S. Tyler. He was graduated from Columbia University in the class of '87. He entered the employ of the elevator firm, of which corporation he soon became a member. He was a director of the Flatbush Trust Company and vice-president and director of the Home Title Insurance Company. He was a member of the Hamilton Club and the Crescent Athletic Club, and a trustee of the Church of the Pilgrims.

Educational.

UNIVERSITY OF CINCINNATI.—A pamphlet has been issued as to the co-operative course in engineering in this university. It contains two interesting papers on the subject by Prof. H. Schneider, of the faculty, and Mr. C. S. Girgrich, M. E. of the Cincinnati Milling Machine Company.

MECHANICAL ENGINEERS AT ILLINOIS UNIVERSITY.—"More ideas to the square foot than anything I have heard for months," was the way Prof. Breckenridge characterized the address of Mr. R. D. Tomlinson before the engineering students of Illinois University. Mr. Tomlinson is one of the best-known authorities on steam engineering, particularly power-plant work, in this country, and has until lately been connected with the Interborough Rapid Transit Company, of New York City. He is now in the employ of the Allis-Chalmers Company as a specialist on steam condensers. It was on the subject of condensers that he spoke to the engineers. With the aid of lantern slides he described in detail the condenser installations in all of the chief power stations in New York City. Here the impossibility of obtaining good condensing water, combined with the necessity of "keeping things moving," make the problem one of great difficulty. The solution has been largely in the use of jet condensers, as surface condensers are rapidly corroded by electrolysis. The construction of several of the most important of these was discussed at length. Mr. Tomlinson urged the necessity for large and direct exhaust piping and the use of large-radius elbows as absolutely necessary for high efficiency with condensing engines. In closing, Mr. Tomlinson gave the students some good advice relative to getting out and doing a couple of years' practical shop work before taking up the office work side of the profession.

Trade Publications.

SWITCHBOARD PANELS for three-phase systems are illustrated, listed and briefly described in Bulletin No. 94 of the Crocker-Wheeler Company, Ampere, N. J.

OIL SWITCHES.—Bulletin No. 9 of the Hartman Circuit Breaker Company, Mansfield, Ohio, describes automatic and non-automatic oil switches for either switchboard or wall mounting.

STEAM ENGINE NOMENCLATURE.—Bulletin No. 7, series D, of the Murray Iron Works, Burlington, Iowa, gives a pictorial illustration of the nomenclature used with Murray Corliss engines.

SWITCH BOXES.—The Chicago Fuse Wire & Mfg. Co., Chicago, Ill., has issued Catalogue No. 21, dealing with "Union" switch boxes for both new and old work. These boxes are adapted for all makes of switches and receptacles.

DIRECT-CONNECTED DIRECT-CURRENT GENERATORS are briefly described in bulletin No. 1102 of the Fort Wayne Electric Works, Fort Wayne, Ind., which gives a complete list of these machines installed by the firm throughout the United States.

THE NATIONAL CARBON COMPANY, of Cleveland, Ohio, has sent us its annual calendar, which is an artistic reproduction of a painting by Philip Boileau, in colors. A feature of the calendar which will appeal to central stations is the moonlight schedule which is combined with the ordinary calendar feature.

HABISHAW WIRE COMPANY, 253 Broadway, New York City, has issued a calendar for 1908 the sheets of which show views of some of the larger buildings in which Habishaw wires and cables have been used in the past few years—such as the new Hall of Records in New York City, the Hotel Belmont, the Railroad Exchange, Chicago; the Machesney Building, Pittsburg.

TAPES.—The New York Insulated Wire Company has just issued a leaflet giving prices and a general description of its friction and rubber tapes. A copy, together with samples, can be obtained by those interested by addressing a request to the company.

ALTERNATING CURRENT FANS are described in minute detail in a 59-page booklet designated as Catalogue No. 4700 of the Emerson Electric Manufacturing Company, St. Louis, Mo. All of the fan motors are of the induction type, an arrangement being made for opening the starting-coil circuit when full speed is reached.

WATT-HOUR METERS.—The Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., has issued circular No. 1137, giving complete descriptions of watt-hour meters for all services. Connection diagrams are given for single-phase, polyphase, direct-current and three-wire systems.

ADJUSTABLE-SPEED MOTORS, having a speed range of from 2 to 1 to 3 to 1, of the field-weakening type, are described in bulletin No. 89 of the Crocker-Wheeler Company, Ampere, N. J. These motors are not provided with auxiliary field poles, sparkless operation being obtained as a result of special care devoted to details of design.

ARC LIGHTING SYSTEM.—Bulletin No. 1103 of the Fort Wayne Electric Works, Fort Wayne, Ind., gives an excellent description with diagrams of the Wood series alternating-current arc lighting system. One of the distinctive features of this system is the regulator which automatically varies the impedance in the lamp circuit and thereby holds the current constant.

PUMPING MACHINERY.—General catalogue K-800 of the Knowles Steam Pump Works, East Cambridge, Mass., is a 173-page publication devoted to types and combinations of machines that will meet the general requirements of pump users. Views are given of several direct-connected motor-driven pumps, a noteworthy example being an 800-hp set for lifting 1600 gallons per minute against a pressure corresponding to 1550 feet.

"COMMON SENSE" is the name of a neat monthly pamphlet about 16mo size, just begun issuance by the Electric Controller & Supply Company, of Cleveland. It is well printed and, in additional to text that is excellent literature, it embodies appropriate data about the Dinkey controllers, the lifting magnets, etc. The price of extra copies is 10 cents. The December and January numbers have been published. Mr. David Gibson is editor and Mr. W. A. Ten Winkel manager of the publicity department on behalf of the company.

MOTOR-DRIVEN FLOUR MILLS.—Bulletin No. 1205 of the Allis-Chalmers Company, entitled "Keewatin Flour Mills," contains a complete description of this mill, as well as 50 halftone illustrations showing other plants, the complete equipment of which has been furnished by the company. A distinctive feature of the recently completed plant of the Keewatin mills, which has an output of 5000 bbls. daily, is the electrically driven apparatus. Standard induction motors are used not only in the mill, but also for operating all the machinery in the elevator building.

UTILIZATION OF EXHAUST STEAM.—The Harrison Safety Boiler Works, Seventeenth Street and Allegheny Avenue, Philadelphia, is sending out a quite unusual mail folder on "The Utilization of Exhaust Steam in Wood Working Establishments." With the exception of what is said about the use of exhaust steam in dry kilns and for steaming lumber, the points brought out apply to most steam plants, covering the use of the Cochrane open feed water heaters and the hot process system of water purification for keeping hard scale out of boilers, increasing the capacity of the boilers and saving coal and boiler feed water. The folder shows an interesting layout for engine, heater, drying and heating coils and connections.

WATT-HOUR METERS.—Bulletin No. 10, of the Sangamo Electric Company, Springfield, Ohio, gives an excellent technical description of watt-hour meters for both direct-current and alternating-current circuits. The motors in these meters are of the mercury type, the thin copper driving-disk floating upon mercury. The rotation of this disk is caused by the torque action of the current in it against a magnetic field produced in a circuit in shunt to the main supply system. Bulletin No. 11, of the same company, deals particularly with watt-hour meters for switchboard use. The company has also issued a valuable pamphlet giving information to salesmen and engineers regarding the theory, construction, installation, operation and testing of watt-hour meters.

POLYPHASE MOTORS.—The Wagner Electric Manufacturing Company, St. Louis, has just issued a pamphlet entitled "The Polyphase Motor in the Shop." This is a description of the repair shops of the Wabash Railroad Company, located at Decatur, Ill., which installation is driven by Wagner three-phase motors exclusively. This book will appeal more particularly to the readers of this journal on account of the tables given in the back, showing the power required to drive certain machines, and the average load put upon them by certain classes of work. The tables are really of great value to a person contemplating the purchase of similar machinery, as they are made up from actual tests on the machines while working under normal manufacturing conditions.

HYDRAULIC TRANSMISSION PUMP.—A pump designed to meet the requirements of plants where steam economy is an important factor in the cost of production is the Allis-Chalmers hydraulic transmission pump, described in its bulletin No. 1604. This pump is built for any capacity desired up to 400 gals. per minute and pressures as high as 6000 lbs. per square inch. For capacities and pressure beyond this, Allis-Chalmers Company offers another pump of special design. Pumps of this type are particularly adapted for operating under conditions that entail hard and continuous service, as in mines for forcing fluids through pipe lines, or for the operation of hydraulic presses, lifting machines and cranes, riveting, bolting, forging and testing machines. In view of its wide range of adaptability, a complete description of this pump will be of interest and can be had upon application to its builders.

Unclassified Items.

IRWIN, PA.—The Irwin-Herminie Electric Street Railway Company has been chartered, with a capital stock of $35,000, to build an electric railway between Irwin and Herminie, a distance of 5½ miles. The directors are Holman R. Lynn, of Pittsburg; H. C. Mullin, of McKeesport; W. B. McCan, of Allegheny; A. E. Dubois and C. W. Schenck, of Pittsburg.

MEADVILLE, PA.—The Central Crawford Traction Company has been organized. Dennis Smith is president of the company, and Joseph H. Heard, secretary and treasurer.

NASHVILLE, TENN.—The French Broad River Power Company has been incorporated, with a capital stock of $10,000, by W. A. Boyce and others.

THE MASSACHUSETTS CHEMICAL COMPANY, of Walpole, Mass., manufacturer of insulating tapes, varnishes, etc., is about to open a branch office in Chicago, to be located at 464 Monadnock Building. Mr. Arthur E. Duclos, well known to the electrical trade in the Middle West, will be in charge.

THE STANDARD AUTOMATIC SWITCH & ELECTRICAL DEVELOPMENT COMPANY, of Brooklyn, N. Y., has filed articles of incorporation, with a capital stock of $10,000. The directors are Leonard Colson, Charles Gebauer, Sr., of Brooklyn; Joseph L. Conte, of New York, N. Y.

THE ARTHUR FRANTZEN COMPANY, of Baltimore, Md., has been incorporated, with a capital stock of $10,000, for the purpose of conducting a general electrical supply business, by William McGuineas, Robert L. Gill, William G. Speed, Arthur J. Bruen, all of Baltimore, and William H. Rottenburd, of Chicago, Ill.

THE ELECTRIC PERFECT FILTER COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000, by Charles Watson, of Seattle, Wash.; E. A. Cohn and Samuel Packard, of New York, N. Y.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutacal Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring Meeting, Detroit, Mich., June 23-26, 1908.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby. 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual Meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Simmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Assistant secretary, J. A. Harney, Monadnock Block, Chicago.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Central Station Men's Association. A. H. Lane, Glencoe, Minn., temporary chairman. Next meeting at Hotel Nicollet, Minneapolis, Feb. 28 and 29.

Missouri Independent Telephone Association. Secretary, Houck McHenry, Jefferson City, Mo.

Missouri State Electric Light Association. Secretary, C. Z. Pierson, St. Charles, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting Aug. 25, 26 and 27, 1908.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Charles W. Ford, Oklahoma City, Okla.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 21, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

876,923. STARTING MOTOR CONVERTER; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed May 31, 1907. Relates to motor converters of the type comprising an induction motor and rotary converter with their armatures mechanically and electrically coupled. Provides starting means adapted to insure sufficient field magnetization on reaching normal speed to hold the generator set at that speed.

876,924. COMPENSATED MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed July 19, 1906. In combination, a plurality of motors of the commutator type, each having a compensating winding with a smaller number of turns than the effective turns of the armature, and means for connecting a plurality of motors with their armatures in parallel with each other and their compensating windings in series with each other and with the armatures.

876,930. DYNAMO ELECTRIC MACHINE; Sven R. Bergman, Lynn, Mass. App. filed May 8, 1907. Rotor construction for dynamo electric machines designed to obtain the advantages of both closed and open slots for the windings without the attendant disadvantages of either type.

876,939. INSULATOR; Harold W. Buck, Niagara Falls, N. Y. App. filed July 29, 1902. Cylindrical ribbed insulators are supported by metallic trunions between projecting arms on the telegraph poles.

876,943. DYNAMO ELECTRIC MACHINE; Charles E. Canfield, Norwood, Ohio. App. filed June 8, 1904. Form of dynamo electric machine adapted to be directly driven by high-speed steam turbines.

876,944. RAILWAY SIGNAL; Fred B. Corey, Schenectady, N. Y. App. filed Oct. 6, 1905. Provides means by which the discs or roundels of a semaphore signal system are prevented from being obscured by snow and sleet, and further by which they are thrown into danger position whenever the operating mechanism is disabled.

876,945. ARC LAMP; George W. Cravens, Schenectady, N. Y. App. filed Sept. 16, 1904. In an arc lamp, a pair of electrodes between which an arc is maintained, means for normally maintaining the arc directed, and means for automatically changing the position of the arc deflecting means to compensate for the change in position of the arc resulting from the consumption of the electrodes.

876,949. ARMATURE BANDING; Malcolm Dickerson, Newark, N. J. App. filed Oct. 10, 1905. A form of "banding" for dynamo electric machines adapted to prevent the excessive induced current losses due to the usual spiral wire banding. Makes use of insulating plates between the layers of the windings.

876,952. RELEASE MECHANISM FOR MORSE TELEGRAPHS; Eugene Ducretet, Paris, France. App. filed June 15, 1905. A device for automatically or manually arresting the paper feed mechanism of a Morse receiving instrument whereby the paper feed is controlled by the operation of the machine.

876,953. RAILWAY SIGNALING SYSTEM; Carl Enderlein, Cassel, Germany. App. filed March 22, 1906. Has a plurality of cam drums by which the switching and signaling circuits are completed in a proper sequence.

876,955. DYNAMO ELECTRIC MACHINE; Russell S. Feicht, Pittsburg, Pa. App. filed Oct. 3, 1905. Provides suitable resistance rings for induction motors which may be easily applied and are of ventilated construction.

876,956. GAS CAP; Richard Fleming, Lynn, Mass. App. filed May 4, 1905. A gas cap for an enclosed arc lamp having a feed opening for the movable electrode of larger clearance at the top than bottom, and a long tubular duct between the openings communicating with the inner globe.

876,970. ELECTRIC SWITCH; Walter F. Jones, Eccles, near Manchester, England. App. filed July 13, 1907. A controller comprising a conducting ring having a set of integral contact projections and an alternating set of insulated contact projections, and a frame having contact fingers to engage said contact projections, said frame and ring being relatively rotatable.

876,973. MOTOR COOLING DEVICE; Arthur F. Knight, Schenectady, N. Y. App. filed Aug. 25, 1902. Provides means for cooling an electric motor and including a form of fan secured at the end of the armature shaft.

876,979. POTENTIAL REGULATOR; Edwin Lehr, Wilkinsburg, Pa. App. filed Nov. 13, 1905. Provides a system of feeder regulation for three-phase, alternating-current systems of distribution. Is designed to properly regulate the potential between lines and preserve the relative phase relations of the electromotive force imposed upon the outgoing circuits.

876,984. ELECTRIC FUSE; Frederick Mackintosh, Schenectady, N. Y. App. filed Sept. 29, 1904. The fuse is made of tubular form in an enclosed chamber so that it will collapse by the expansion of the air in the chamber and automatically extinguish the arc.

876,988. TRANSFORMER FOR ELECTRIC VEHICLES; Walter S. Moody, Schenectady, N. Y. App. filed Aug. 10, 1904. A construction of transformer for electric motor cars designed to be of light weight and strong construction to stand the shocks of this class of apparatus.

876,993. MOTOR CONTROL; Karl A. Pauly, Schenectady, N. Y. App. filed May 18, 1907. A system for controlling the motors of a rolling mill by which the latter may be run at a plurality of speeds and at widely differing conditions of load at each speed.

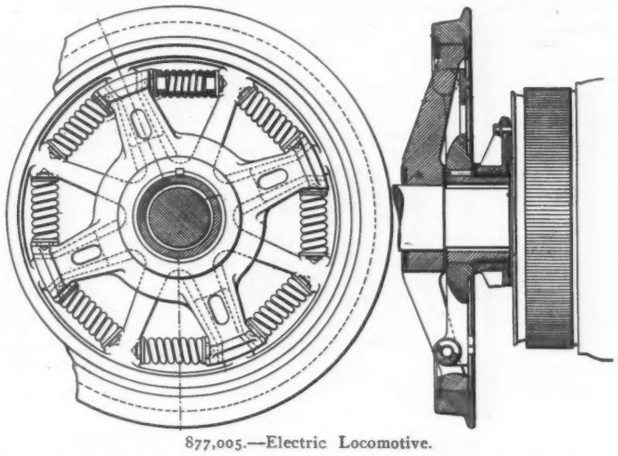
876,996. INTELLIGENCE INTERCOMMUNICATION BY MAGNETIC WAVE COMPONENTS; G. W. Pickard, Amesbury, Mass. App. filed June 10, 1907. Has closed electrical circuit of large area in inductive relation, and detector circuits, etc.

876,997. ELECTRICAL DENTAL AND SURGICAL APPLIANCE; Harry F. Pressey, Bridgeport, Conn. App. filed April 24, 1907. A miniature incandescent lamp is mounted on a rod so as to be operable as a dental tool. The apparatus includes a specially constructed resistance element by which the light can be adjusted.

876,998. MEANS FOR SUPPORTING BRUSH HOLDERS; Edward D. Priest, Schenectady, N. Y. App. filed Dec. 18, 1905. A means for supporting brush holders and associated with the propelling motors of electric locomotives. It is designed to be specially rigid in its adjustment upon the frame members.

877,002. TELEGRAPH SYSTEM; Harry O. Rugh, Sandwich, Ill. App. filed Dec. 26, 1906. Complete telegraph system having operating batteries at each station and means at one sending station and governed at another sending station for preventing the connection of battery thereat with the line.

877,005. ELECTRIC LOCOMOTIVE; Richard Schwarz, Schenectady, N. Y. App. filed Oct. 18, 1906. Has compression springs between the spokes of the driving wheel and the motor armature spider, one



877,005.—Electric Locomotive.

set of springs being hollow and partly surrounding a portion of the spokes of the other set.

877,016. ELECTRIC MOTOR; Leonard A. Tirrill, Lynn, Mass. App. filed June 7, 1906. An electric motor with a power transmitting shaft coupled to the armature shaft by a motor and a speed changing mechanism.

877,017. DYNAMO ELECTRIC MACHINE WITH COMPENSATING WINDINGS; Ludwig Torda, Cheswick, England. App. filed March 8, 1907. Has a compensating device with associated elements to carry the compensating current and also the main magnetic lines.

877,018. OPERATION OF STORAGE BATTERIES IN CONNECTION WITH ALTERNATING-CURRENT SYSTEMS; Joseph H. Tracy, Philadelphia, Pa. App. filed June 21, 1907. Provides for operating a storage battery in connection with an alternating-current system through a rotary converter and distributer.

877,026. TRANSFORMING THE ENERGY OF ELECTRIC CURRENTS; E. Weintraub, Schenectady, N. Y. App. filed July 23, 1903. Renewed July 13, 1907. The combination of a vapor conductor, a plurality of electrodes, one of which is a cathode, and a magnetic means for shifting the cathode spot.

877,028. MOTOR CONTROL; Harold E. White, Schenectady, N. Y. App. filed July 25, 1906. Provides an arrangement of switches whereby the manual control of a motor may be obtained at starting and automatic control secured when the motor is up to speed.

877,030. MOTOR CONTROL; Carl E. Zix, Berlin, Germany. App. filed July 25, 1906. Relates to the control of electric motors from a distance, and particularly to the control of motors driving a member such as a railway track switch which must be reciprocated.

877,033. SWITCHING MECHANISM FOR TELEPHONE CIRCUITS; Albert K. Andriano, San Francisco, Cal. App. filed March 15, 1905. Details of construction of standard transmitter.

877,058. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Nov. 11, 1903. Covers details of cord circuit.

877,067. AUTOMATIC TRANSMITTER FOR FIRE-ALARM AND SPRINKLER SYSTEMS; James Fiddes and John F. Watt, Aberdeen, Scotland. App. filed Oct. 26, 1906. A fire-alarm and sprinkler system designed to communicate automatically with the fire brigade station or other point and indicate when automatic sprinkler or fire-alarm in a building has been brought into action.

877,069. MAGNETIC DETECTOR; Lee de Forest, New York, N. Y. App. filed Nov. 2, 1903. A magnetic oscillation detector comprising a plurality of cores and coils thereon grouped about a common axis, and a magnet mounted to turn upon a coincident axis.

877,089. METHOD OF MAKING ELECTRIC CONDENSERS; Frank S. Koch, Chicago, Ill. App. filed Aug. 15, 1904. A method of constructing condensers in as compact a manner as possible whereby they may be placed flatwise against the interior edges of the various electrical apparatus with which they are used. The condenser is subjected to very powerful pressure during manufacture.

877,101. CLIP FOR FIXING WIRES TO INSULATORS; Johann Macek, Vienna, Austria-Hungary. App. filed Jan. 29, 1907. A form of cleat for fixing conducting wires to insulators. Has a plurality of wire links which are engaged around the insulators by a thumb-nut.

877,121. TELEPHONE SYSTEM; Howard M. Post, Chicago, Ill. App. filed Nov. 11, 1903. Details of cord circuits.

877,144. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Max Vogelsang, Frankfort-on-the-Main, Bockenheim, Germany. App. filed Feb. 2, 1905. Synchronizing switch for connecting and disconnecting alternating-current generators from the main.

877,154. ELECTRICAL ABDOMINAL HEATER; Hiram D. Wood, Jr., Minneapolis, Minn. App. filed July 3, 1907. An electrical part having a spirally arranged resistance filament disposed on a spider-shaped support between asbestos layers.

877,155. ELECTRICAL FACE STEAMERS; Hiram D. Wood, Jr., Minneapolis, Minn. Relates to modifications of the above.

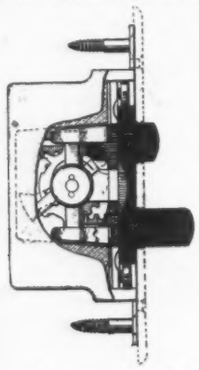
877,171. METHOD OF MANUFACTURING METALLIZED ELECTRIC INCANDESCENT LAMP FILAMENTS; Francis M. F. Cazin, Hoboken, N. J. App. filed Aug. 15, 1904. The method of producing glowers for electric incandescent lamps which consists in coating or metallizing carbon filaments, when bent into their final longitudinal shape, with a coat, deposit or layer or layers of metal in an electrolytic plating apparatus.

877,172. METHOD OF PRODUCING FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS AND THE PRODUCT OF SUCH METHOD; Francis M. F. Cazin, Hoboken, N. J. App. filed Sept. 21, 1904. A filament in an electric incandescent lamp primarily consisting of a conductive core coated, when longitudinally bent into its final and main filament shape, with an electrolytic metal cover.

877,177. ELECTRIC HEATER; Henry D'Olier, Jr., Philadelphia, Pa. App. filed Jan. 13, 1906. A heater adapted to be directly attached to a faucet and having a cylindrical resistance element past which the water is caused to flow. The circuit is completed by the usual handle of the stopcock.

877,188. ELECTRIC HEATER; George W. Elkins, Elkins Park, Pa. App. filed Jan. 13, 1906. Relates to modifications of the above.

877,242. INSULATOR PIN; Delos V. Snapp, Holdrege, and Charles W. Fraher, Lincoln, Neb. App. filed June 21, 1907. A form of insulator



877,301.—Wall Switch.

pin having a base bolted to the crossarm and a threaded plug thereon which receives the insulator.

877,251. ELECTRICAL MEASURING INSTRUMENT; William J. Still, Ealing, England. App. filed June 23, 1905. A pocket indicator for batteries, etc., having a solenoid which attracts a longitudinally moving core having a pointer.

877,258. AUTOMATIC REGULATING DEVICE; Percy H. Thomas, Montclair, N. J. App. filed June 16, 1905. An electrical distribution system in which means are provided for delivering to a consumption circuit the proper amount of electrical energy for satisfying the monetary needs thereof.

877,284. ELECTRIC APPARATUS FOR THE IGNITION OF MINES; Otto R. P. Berglund, Walter A. W. E. Hjorth and Carl E. Ljungman, Stockholm, Sweden. App. filed Oct. 25, 1905. A battery operated magneto having a sector gear and a circuit completing device operated during the movement of said gear.

877,301. WALL SWITCH; John H. Dale, New York, N. Y. App. filed May 18, 1906. Designed to have an abrupt movement in completing and opening the circuit and in which the switch elements are moved through a very direct application of the operating force. For this purpose there are provided racks on the separate buttons which engage sector gears on the part which is co-axial with and throws the switch element. Has a special form of displaceable detent for insuring an abrupt spring-impelled movement of the switch element.

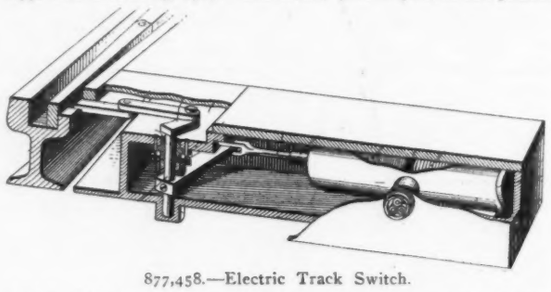
877,311. ELECTRIC SIGNALING APPARATUS; Sydney Evershed, London, England. App. filed Dec. 23, 1905. Relates to telegraphic apparatus intended for the transmission of a limited number of prearranged signals for shipboard, etc. Makes use of two circuits, the current in which is separately variable.

877,312. ELECTRICAL TRANSMISSION APPARATUS; Sydney Evershed, Chiswick, England. App. filed Feb. 28, 1906. Relates to modifications of the above.

877,319. TRANSFORMER EMPLOYED IN HIGH-FREQUENCY CURRENT CIRCUITS; Georges E. Gaiffe, Paris, France. App. filed Nov. 8, 1904. Provides resistances either alone or in conjunction with capacities and connected to the extremities of the secondary of a transformer with the object of damping the high-frequency oscillations which tend to traverse the same.

877,326. ELECTRIC LIGHT SOCKET CAP; John H. Goss, Waterbury, Conn. App. filed May 29, 1907. A means for fastening the heads to the caps of electric light sockets so as to avoid the use of washers and secure certain other functions.

877,379. TROLLEY REPLACER; George Q. Seaman, New York, N. Y. App. filed March 23, 1907. The trolley pole is pivoted independently



877,458.—Electric Track Switch.

of the spring-impelled element and has a ratchet connection therewith. This ratchet is released when the pole moves suddenly upward so that the latter falls on a "cradle" to restore the same when desired.

877,383. MEANS FOR SECURING CORDS TO LAMP SOCKETS; Frederick A. Swan, Cliftondale, Mass. App. filed March 15, 1907. The cord is knotted through a chamber in the receptacle in a special way so as to take the train off the terminal screws.

877,384. ELECTRICAL FITTING; Frederick A. Swan, Cliftondale, Mass. App. filed April 22, 1907. Another construction in which the cord is received through a special cleat or plate.

877,408. MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS; Francis M. F. Cazin, Hoboken, N. J. App. filed March 17, 1904. A luminant for electric incandescent lamps, consisting of a carbon fillet, a surrounding layer of a mixture of carbon and metals, and a layer of the ruthenium-osmium metals surrounding the same.

877,427. CIRCUIT CONTROLLER; Lemuel F. Howard, Edgewood Park, Pa. App. filed Aug. 3, 1906. A circuit controller for use in connection with railway appliances, particularly for power operated switch and like movements.

877,439. APPARATUS FOR MAGNETICALLY CONCENTRATING ORES; H. Leighton, Seattle, Wash. App. filed Sept. 19, 1906. Relates to the magnetic separation of substances having magnetic permeability from ores and mixtures with which they are associated, by passing said ores or mixtures in a comminuted or granular state through a magnetic field. Has an inclined belt for feeding material into proximity to the projecting magnet poles.

877,442. LIGHTNING ROD; L. L. Mast, West Milton, Ohio. App. filed July 27, 1906. A lightning rod formed of tubular sheet metal with a longitudinally flattened portion through which the rod may be nailed to the wall of the dwelling.

877,446. APPARATUS FOR MANUFACTURING NITRIC ACID OR OXID FROM AIR; Harry Paulding, Gelsenkirchen, Germany. App. filed Dec. 18, 1905. In an apparatus for manufacturing nitric acid or oxid from air, in combination, electrodes, arranged in a plane, for producing electric discharges, a number of plates so disposed at one side of such electrodes as to cut the plane of the latter at right angles and form interspaces lying crosswise of the electrodes, means arranged at the opposite side thereof for blowing a current of gas through the space between the electrodes, and means for insulating the said plates from each other, substantially as described.

877,451. MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES; G. W. Pickard, Amesbury, Mass. App. filed Nov. 12, 1907. An electrolytic detector for wireless telegraph systems and having two substantially massive individual conductors of different conductivity in engagement with one another and in combination with a mass of fusible metal supporting the high-resistance conductor.

877,458. ELECTRIC TRACK SWITCH; R. A. Baldwin, New Haven, Conn. App. filed Dec. 5, 1906. An automatic track-switch mechanism including circuits for its operation. The switchpoint is positively moved in either direction of its throw by manipulation of the car controller, and without any necessity of the motorman actually seeing the switchpoint. Also provides for locking the switchpoint against return movement. The mechanism is so constructed that all of the operating parts are hermetically closed in a watertight casing.

877,464. RAILWAY SIGNAL; J. C. Link, Highbridge, Wis. App. filed March 25, 1907. A dispatcher's signaling apparatus by which certain telegraph messages are transmitted when the signal is set at predetermined relation.

877,467. COOLING SYSTEM FOR ELECTRIC RAILWAY APPARATUS; Walter S. Moody, Schenectady, N. Y. App. filed Aug. 10, 1904. Divided and this app. filed June 16, 1906. Employs the exhaust from air-brake system.

877,477. PROCESS FOR THE PRODUCTION OF PURE NITRIC ACID; Harry Pauling, Gelsenkirchen, Germany. App. filed April 6, 1906. The process consisting in subjecting atmospheric air to the action of electrical discharges, mixing the nitrogenous gases, thus formed, with water or aqueous vapor while the said gases have a minimum temperature of 200 deg. C., and cooling down the mixture as set forth.

877,448. PROCESS FOR THE PRODUCTION OF VOLTAIC STRONG-CURRENT ARCS; Harry Pauling, Gelsenkirchen, Germany. App. filed June 30, 1906. The process consisting in passing a gas to be acted upon by electrical discharges, in two currents between a pair of electrodes, the latter diverging in two different directions, one of the said currents passing in one of these directions, the second current in the other direction, substantially as set forth.